PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-037762

(43)Date of publication of application : 10.02.1994

(51)Int.Cl. H04L 12/28

(21)Application number : 04-189700

(22)Date of filing : 16.07.1992

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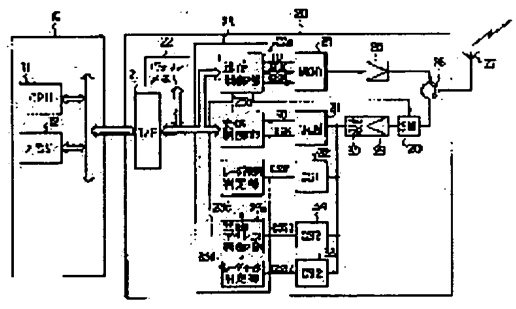
(54) RADIO COMMUNICATION EQUIPMENT

(57)Abstract:

PURPOSE: To realize the radio communication system newly by implementing radio communication without giving adverse effect such as interference or disturbance onto an inside of a radio area of an existing radio system and utilizing a desired frequency band.



CONSTITUTION: A radio communication terminal equipment TU is provided with a 1st carrier detection circuit 32, a radar operation discrimination section 23c, a 2nd carrier detection circuit 33 and a radar interference discrimination section 23d in addition to a 3rd carrier detection circuit 34 required for transmission of a radio packet according to the CSMA system, the 1st carrier detection circuit 32 and the radar operation discrimination section 23c are used to discriminate whether or not a radar system RSM uses a radio channel, and the 2nd carrier detection circuit 33 and the radar interference discrimination section 23d are used to discriminate whether or not there is any possibility of giving cross modulation to the radar system RSM and the use of the radio channel is controlled based on the discrimination.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Cited Reference of
Japanese Patent Application No. 2002-580665
D1: JPA H06-037762

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開平6−37762

(43)公開日　平成６年(1994)２月10日

(51)Int.Cl.⁵	識別記号	庁内整理番号	F I		技術表示箇所
ＨＯ４Ｌ　12/28					
		8529−5K	ＨＯ４Ｌ　11/ 00	３１０　Ｂ	

審査請求　未請求　請求項の数５（全 12 頁）

(21)出願番号　特願平4−189700

(22)出願日　平成４年(1992)７月16日

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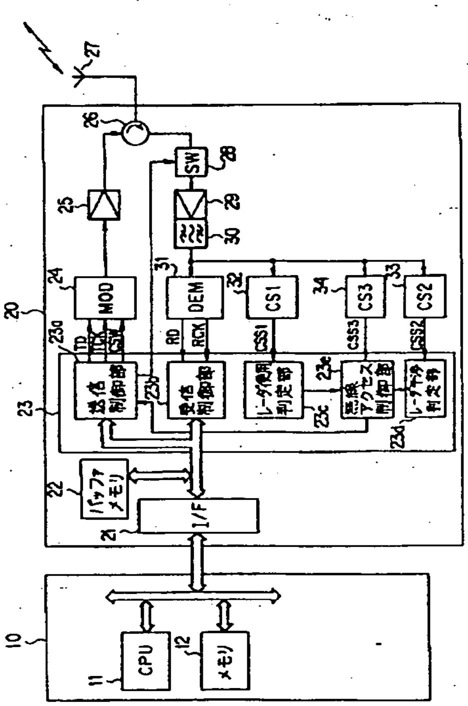
(54)【発明の名称】　無線通信装置

(57)【要約】

【目的】　既存の無線システムの無線エリア内において干渉妨害などの悪影響を及ぼすことなく無線通信を行なえるようにし、これにより所望の周波数帯を利用して新たな無線通信システムを実現する。

【構成】　無線通信端末装置ＴＵに、ＣＳＭＡ方式に従って無線パケット伝送を行なうために必要な第３のキャリア検出回路３４とは別に、第１のキャリア検出回路３２およびレーダ使用判定部２３ｃと、第２のキャリア検出回路３３およびレーダ干渉判定部２３ｄとを設け、第１のキャリア検出回路３２およびレーダ使用判定部２３ｃによりレーダシステムＲＳＭが無線チャネルを使用しているか否かを判定するとともに、第２のキャリア検出回路３３およびレーダ干渉判定部２３ｄによりレーダシステムＲＳＭに混変調を与える可能性があるか否かを判定し、これらの判定を基に無線チャネルの使用を制御するようにしたものである。



【特許請求の範囲】

【請求項１】　複数の無線チャネルの中から特定の無線チャネルを選択的に使用する第１の無線システムと無線チャネルを共用して無線通信を行なう第２の無線システムで使用される無線通信装置において、

前記複数の無線チャネルのうち選択された無線チャネルを介して伝送された無線信号を受信し、その受信結果に基づいて前記第１の無線システムによる当該無線チャネルの使用状態を判定するための第１の判定手段と、

前記選択された無線チャネルを介して伝送された無線信号を受信し、その受信結果に基づいて、当該無線チャネル以外の無線チャネルを使用して無線信号を送信した場合であっても前記第１の無線システムに混変調を与える可能性があるか否かを判定するための第２の判定手段と、

前記第１の判定手段により前記選択された無線チャネルが前記第１の無線システムにより使用中と見なせる状態にあると判定された場合には当該無線チャネルの使用を回避するとともに、前記第２の判定手段により前記第１の無線システムに混変調を与える可能性があると判定された場合には前記すべての無線チャネルの使用を回避するための処理を実行する無線チャネル使用制御手段とを具備したことを特徴とする無線通信装置。

【請求項２】　第１の判定手段は、選択された無線チャネルを介して伝送された無線信号の信号レベルを所定の第１のしきい値レベルと比較する比較手段と、上記伝送された無線信号の信号長および信号の周期性のうちの少なくとも一方を検出する検出手段と、上記比較手段による信号レベルの比較結果と上記検出手段による信号長または信号の周期性の検出結果とを選択的に使用して、第１の無線システムによる当該無線チャネルの使用の有無を判定する手段とを備えたことを特徴とする請求項１に記載の無線通信装置。

【請求項３】　第１の判定手段は、第１のしきい値レベルとして、自装置が送信した無線信号が前記第１の無線システムで想定される最小受信感度レベルに対して所定の余裕をもって受信されるべく設定されたしきい値レベルを有することを特徴とする請求項２に記載の無線通信装置。

【請求項４】　第２の判定手段は、選択された無線チャネルを介して伝送された無線信号の信号レベルを前記第１のしきい値レベルとは異なる所定の第２のしきい値レベルと比較する比較手段と、上記伝送された無線信号の信号長および信号の周期性のうちの少なくとも一方を検出する検出手段と、上記比較手段による信号レベルの比較結果と上記検出手段による信号長または信号の周期性の検出結果とを選択的に使用して、前記第１の無線システムに対し混変調を与える可能性が有るか否かを判定する手段とを備えたことを特徴とする請求項１に記載の無線通信装置。

【請求項５】　第２の判定手段は、第２のしきい値レベルとして、自装置が送信した無線信号が前記第１の無線システムで混変調を来すと想定される最小受信信号レベルに対して所定の余裕をもって受信されるべく設定されたしきい値レベルを有することを特徴とする請求項４に記載の無線通信装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、無線ＬＡＮ（local area netwoak）システムなどの無線通信システムで使用される無線通信装置に係わり、特にレーダシステム等の既存の無線システムの無線エリア内でその無線チャネルを共用して無線通信を行なうために使用される無線通信装置に関する。

【０００２】

【従来の技術】近年、通信ニーズの増大や無線通信技術の進展に伴い種々の無線通信システムが提唱されており、その一つに無線ＬＡＮシステムがある。この無線ＬＡＮシステムは、例えばオフィスビルや事業所などの比較的限定されたサービスエリアにおいて、ホストコンピュータやパーソナルコンピュータ、プリンタ、電子ファイル装置等の端末装置相互間でデータを無線伝送するものである。

【０００３】ところで、この種のシステムのデータ伝送速度としては、例えばＩＥＥＥ８０２．３　ＣＳＭＡ／ＣＤ方式に代表されるように１０Ｍｂｐｓ以上の速度が望まれており、この伝送速度を実現するためには数十ＭＨｚ以上の帯域幅が必要となる。また、この種の無線ＬＡＮシステムを実現する場合の周波数帯域としては、無線装置の消費電力低減のために自由空間損失が小さいことや、無線装置の低廉化のためにシリコンデバイスが利用可能であることなどから、３ＧＨｚ以下の準マイクロ波帯が好適である。しかし、準マイクロ波帯では大半の周波数が他の既存のシステムに割り当て済みであり、無線ＬＡＮシステムのために数十ＭＨｚ以上の帯域を新たに割り当てる余地はないのが実情である。

【０００４】

【発明が解決しようとする課題】以上のように無線ＬＡＮシステムのような新たな無線通信システムを実現しようとしても利用可能な適当な周波数帯がないのが現状であり、このため新たな無線通信システムを実現することが困難な状況にある。

【０００５】本発明は上記事情に着目してなされたもので、その目的とするところは、既存の無線システムに対し干渉妨害や混変調などの悪影響を及ぼすことなく無線通信を行なえるようにし、これにより所望の周波数帯を利用して新たな無線通信システムを実現することができる無線通信装置を提供することである。

【０００６】

【課題を解決するための手段】上記目的を達成するため

に本発明の無線通信装置は、無線チャネルの状態を知るために第１の判定手段および第２の判定手段を備え、第１の判定手段により、上記無線チャネルを介して伝送された無線信号を受信してその受信結果に基づいて既存の第１の無線システムによる上記無線チャネルの使用状態を判定し、さらに第２の判定手段により、無線チャネルを介して伝送された無線信号を受信して、その受信結果に基づいて当該無線チャネル以外の無線チャネルを使用して無線信号を送信した場合であっても上記第１の無線システムに混変調を与える可能性があるか否かを判定している。そして、無線チャネル使用制御手段により、上記第１の判定手段で上記無線チャネルが使用中と見なせる状態にあると判定された場合には当該無線チャネルの使用を回避し、かつ上記第２の判定手段により上記第１の無線システムに混変調を与える可能性があると判定された場合にはすべての無線チャネルの使用を回避するための処理を実行するようにしたものである。

【０００７】また本発明は、第１の判定手段において、選択された無線チャネルを介して伝送された無線信号の信号レベルを比較手段により所定の第１のしきい値レベルと比較するとともに、上記伝送された無線信号の信号長および信号の周期性のうちの少なくとも一方を検出手段にて検出し、上記比較手段による信号レベルの比較結果と上記検出手段による信号長または信号の周期性の検出結果とを選択的に使用して、第１の無線システムによる当該無線チャネルの使用の有無を判定することも特徴とする。

【０００８】その際、上記第１のしきい値レベルは、自装置が送信した無線信号が上記第１の無線システムで想定される最小受信感度レベルに対して所定の余裕をもって受信されるべく設定するとよい。

【０００９】さらに本発明は、第２の判定手段において、選択された無線チャネルを介して伝送された無線信号の信号レベルを上記第１のしきい値レベルとは異なる所定の第２のしきい値レベルと比較手段により比較するとともに、上記伝送された無線信号の信号長および信号の周期性のうちの少なくとも一方を検出手段により検出し、上記比較手段による信号レベルの比較結果と上記検出手段による信号長または信号の周期性の検出結果とを選択的に使用して、上記第１の無線システムに対し混変調を与える可能性が有るか否かを判定することも特徴とする。

【００１０】その際、上記第２のしきい値レベルは、自装置が送信した無線信号が上記第１の無線システムで混変調を来すと想定される最小受信信号レベルに対して所定の余裕をもって受信されるべく設定するとよい。

【００１１】

【作用】この結果本発明によれば、第１の判定手段により無線チャネルの使用状態を判定した結果、既存の第１の無線システムがこの無線チャネルを使用していると見

なせる場合には、この無線チャネルを使用した無線通信が回避される。このため、既存の無線システムと共通の無線エリアでかつ共通の無線チャネルを使用するにも拘らず、既存の無線システムに干渉妨害などの悪影響を及ぼすことなく新たな第２の無線システムを運用することが可能となる。

【００１２】また、第１の無線システムが無線チャネルを使用していないと判定された場合でも、自装置が第１の無線システムの無線通信装置の近傍に位置している場合には、自装置の無線送信によって第１の無線システムの無線通信装置で混変調による干渉が発生する場合がある。しかし本発明では、第２の判定手段により無線チャネルの状態を判定した結果、当該無線チャネル以外の無線チャネルを使用して無線信号を送信した場合であっても、第１の無線システムに混変調を与える可能性があると判定されると、すべての無線チャネルの使用が回避される。このため、既存の第１の無線システムに対し混変調による干渉妨害を引き起こす不具合は確実に防止される。

【００１３】したがって、本発明によれば周波数を新たに割り当てることが不可能な準マイクロ波帯などの周波数帯域を利用して、無線ＬＡＮシステムなどの新たな無線通信システムを容易に実現することが可能となる。

【００１４】また、本発明では、第１の無線システムにより無線チャネルが使用中と見なせる状態にあるか否かを判定する際、および第１の無線システムに混変調を与える可能性があるか田舎を判定する際に、無線信号の受信信号レベルを判定するとともに、信号長および周期性のうちの少なくとも一方を検出し、これらの受信レベルの判定結果および信号長または周期性の検出結果を選択的に使用して判定を行なっている。このため、第１の無線システムが例えば広域レーダシステムのように高いピーク出力レベルを有する無線信号を送出するものであり、かつ第１の無線システム以外の無線信号を送出する装置が至近距離に存在しない場合には、無線信号の受信信号レベルのみで第１の無線システムによる無線チャネルの使用状態を判定することが可能となる。また、至近距離に第１の無線システム以外の無線信号を送出する装置が存在する場合でも、無線信号の信号長または周期性を検出することにより、第１の無線システム以外のシステムの無線信号の影響は低減され、これにより誤判定を起こすことなくより安定かつ確実に第１の無線システムによる無線チャネルの使用状態を判定することが可能となる。

【００１５】

【実施例】以下本発明を実施例に基づいて説明する。

【００１６】図１は、本発明の一実施例に係わる無線ＬＡＮシステムと既存のレーダシステムとの配置関係を示す概略図である。

【００１７】レーダシステムＲＳＭは１個のレーダ基地

局ＲＢＳを有し、このレーダ基地局ＲＢＳを中心とする所定の領域にはレーダ基地局ＲＢＳの送信電力に応じたレーダ無線エリアＥＲが形成される。このレーダ無線エリアＥＲ内には、複数の無線ＬＡＮシステム（図では３システム）ＬＳＭ１～ＬＳＭ３が設置されている。これらの無線ＬＡＮシステムＬＳＭ１～ＬＳＭ３は、いわゆる対等分散形と呼ばれる無線ＬＡＮシステムであり、それぞれ複数の無線通信端末装置ＴＵ１１～ＴＵ１４，ＴＵ２１～ＴＵ２３，ＴＵ３１～ＴＵ３４を収容している。対等分散形の無線ＬＡＮシステムは、システム内に集中制御局を持たず、各無線通信端末装置が各々自律的に通信のための制御を行なって、無線通信端末装置相互間で直接無線データ通信を行なうシステムである。各無線ＬＡＮシステムＬＳＭ１～ＬＳＭ３間の接続は、システム内の任意の無線通信端末装置ＴＵ１４，ＴＵ２３，ＴＵ３１を有線回線ＷＬを介して接続することにより行なわれる。

【００１８】ところで、各無線通信端末装置ＴＵ１１～ＴＵ１４，ＴＵ２１～ＴＵ２３，ＴＵ３１～ＴＵ３４（以後ＴＵと称する）は、例えばホストコンピュータ、パーソナルコンピュータ、プリンタまたは電子ファイル装置を端末装置本体としたもので、例えば次のように構成される。図２はその要部構成を示す回路ブロック図である。すなわち無線通信端末装置ＴＵは、端末装置本体１０と、この端末装置本体１０に付設された無線ＬＡＮアダプタ２０とから構成される。端末本体１０は、ＣＰＵ１１およびメモリ１２などのパケットデータ作成および記憶に必要な構成を有する。

【００１９】無線ＬＡＮアダプタ２０は、上記端末装置本体１０との間でパケットデータ転送を行なうためのバスインタフェース（Ｉ／Ｆ）２１を備えており、このバスインタフェース２１を経て端末装置本体１０から転送された送信パケットデータは、バッファメモリ２２に一時蓄積されたのちアクセスコントローラ２３の送信制御部２３ａに入力される。アクセスコントローラ２３の送信制御部２３ａは、上記送信パケットデータＴＤが入力されると、この送信パケットデータＴＤおよび送信クロックＴＣＫをキャリアスイッチ信号ＣＳＷとともに変調回路（ＭＯＤ）２４へ供給する。

【００２０】変調回路２４は、先ず上記送信パケットデータＳＤに対し誤り訂正符号化処理を行なう。そして、この誤り訂正符号化された送信パケットデータＴＤを３分割して３個の異なる変調器に入力する。これらの変調器は、それぞれ上記３分割された送信パケットデータに応じて周波数が異なる３つの搬送波ｆ１～ｆ３を変調する。また変調回路２４は、上記３分割された各送信パケットデータを基にパリティ情報を生成し、このパリティ情報を他の変調器に入力する。この変調器は上記パリティ情報に応じて第４の搬送波ｆ４を変調する。これら４つの変調器から出力された被変調搬送波信号は、合成されたのち送信電力増幅器２６に入力される。送信電力増幅器２５は、上記４波合成被変調搬送波信号をシステムで規定された送信レベルに増幅する。このとき、送信レベルは例えば２．５ｍＷ／キャリアに設定される。このため、上記のように４波を合成した被変調搬送波信号は合計１０ｍＷとなって出力される。この送信電力増幅器２５から出力された４波合成被変調搬送波信号は、サーキュレータ２６を介してアンテナ２７に供給され、このアンテナ２７からシステム内の他の無線通信端末装置ＴＵへ向けて無線送信される。なお、上記キャリアスイッチ信号ＣＳＷは、搬送波を送信する必要がない期間に変調回路２４からの被変調搬送波信号の出力を阻止するための信号である。

【００２１】一方、アンテナ２７で受信された４波合成被変調搬送波信号は、サーキュレータ２６および高周波スイッチ（ＳＷ）２８を経たのち低雑音増幅器２９および帯域通過フィルタ３０に順次入力される。低雑音増幅器２９では上記受信された無線信号が復調処理に必要な信号レベルに増幅される。帯域通過フィルタ３０では、所定の帯域の無線周波成分のみが抽出される。なお、高周波スイッチ２８は、送信時にアンテナ２７で反射した送信無線信号が受信系に回り込むことを防止するために設けられたもので、アクセスコントローラ２３から出力される制御信号に従って受信期間のみ導通する。

【００２２】上記帯域通過フィルタ３０から出力された４波合成被変調搬送波信号は、復調回路（ＤＥＭ）３１、第１のキャリア検出回路（ＣＳ１）３２、第２のキャリア検出回路（ＣＳ２）３３および第３のキャリア検出回路（ＣＳ３）３４にそれぞれ入力される。復調回路３１は、先ず上記４波合成被変調搬送波信号を搬送波ごとに分離して各々復調する。そして、この復調により得られた４つの受信ベースバンド信号をそれぞれ誤り訂正復号処理して受信パケットデータを再生するとともに、これら４つの受信パケットデータを組み合わせてパリティ演算などの誤り検出・訂正演算を行なって正しい受信パケットデータＲＤを再生する。また、この受信パケットデータＲＤを再生する過程で受信クロックＲＣＫを再生する。そして復調回路３１は、上記再生された受信パケットデータＲＤおよび受信クロックＲＣＫをアクセスコントローラ２３の受信制御部２３ｂに供給する。アクセスコントローラ２３の受信制御部２３ｂでは、上記受信パケットデータＲＤおよび受信クロックＲＣＫを基に端末装置本体１０に転送するための受信パケットデータが生成される。そして、この受信パケットデータはバスインタフェース２１を介して端末装置本体１０へ転送される。

【００２３】第１のキャリア検出回路３２は、レーダシステムによる無線チャネルの使用の有無を判定するために、レーダシステムＲＳＭのレーダ基地局ＲＢＳから送信されたレーダパルス信号を検出するもので、受信搬送

波信号のレベルを予め設定された第1のキャリア検出レベルCSL1と比較している。そして、この第1のキャリア検出レベルCSL1よりもレベルの大きい受信搬送波信号が検出されている期間に、第1の検出信号CSS1を発生してアクセスコントローラ23に供給する。

【0024】ここで、上記第1のキャリア検出レベルCSL1は例えば次のように設定される。すなわち、いま仮にレーダ基地局RBSの送信出力が500kW～2000kW（＋87dBm～＋93dBm）であるとし、かつレーダ基地局RBSが無線LANシステムから干渉を受けないための干渉波到着レベルが

－130dBm

とし、さらに無線LANシステムの無線通信端末装置TUの送信電力が

2．5mW（＋4dBm）／キャリア

であるとすると、レーダ基地局RBSに干渉しないための伝送路損失は、

＋4dBm－（－130dBm）＝134dB

になる。このため、この伝送路損失が存在する条件下での無線LANシステムの無線通信端末装置TUにおけるレーダパルス信号の受信レベルは、

87dBm－134dBm＝－47dBm

となる。

【0025】ここで、無線通信端末装置TUからレーダ基地局RBSへ向かう伝送路の伝送路損失が、レーダ基地局RBSから無線通信端末装置TUへ向かう伝送路の伝送路損失に等しいとすれば、無線通信端末装置TUにおけるレーダパルス信号の受信レベルが上記－47dBmのときには、無線通信端末装置TUから送信された無線信号のレーダ基地局RBSにおける受信レベルも－47dBmとなる。すなわち、無線通信端末装置TUにおいてレーダパルス信号の受信レベルが上記－47dBm未満であるときには、レーダ基地局RBSにおける無線通信端末装置TUの無線送信信号の受信レベルも－47dBm未満となり、この状態で無線通信端末装置TUが2，5mW（＋4dBm）の送信電力で無線搬送波信号を送信しても、レーダ基地局RBSでの受信信号レベル＊は－130dBm以下になることから、レーダシステムRSMに対する干渉は生じないことになる。したがって、上記－47dBmを第1のキャリア検出レベルCSL1に設定し、この検出レベルCSL1に従ってレーダパルス信号の検出を行なえばよいことになる。

【0026】なお、実際の装置にあっては、数dBのマージンを見込んで、上記第1のキャリア検出レベルCSL1を例えば－50dBmに設定するとよい。

【0027】一方、レーダシステムRSMでは、その受信系のフロントエンド（前置増幅器）の帯域幅とダイナミックレンジによっては、レーダ波の送受信に使用している無線チャネル以外の無線チャネルを介して無線信号が到来した場合であっても、混変調による干渉を受けることがある。第2のキャリア検出回路33は、この混変調による干渉をレーダシステムRSMに与える可能性があるか否かを判定するためのもので、レーダシステムRSMのレーダ基地局RBSから送信されたレーダパルス信号の受信信号レベルを予め設定された第2のキャリア検出レベルCSL2と比較している。そして、この第2のキャリア検出レベルCSL2よりもレベルの大きい受信信号が検出されている期間に、第2の検出信号CSS2を発生してアクセスコントローラ23に供給している。

【0028】ところで、上記第2のキャリア検出レベルCSL2は例えば次のように設定される。すなわち、レーダシステムRSMが使用中の無線チャネルと異なる無線チャネル周波数ながら、レーダ基地局RBSで受信される無線LANシステムによる近傍周波数の受信電力Pは、以下のように求められる。

$$\Delta P = p_0 \ (\Delta / 4\pi L)^2 \cdot G \cdot Dtr \cdot L\theta \cdot \Delta L$$

ここで、p_0はレーダ受信帯域での無線LANシステムの送信信号レベル、Lはレーダ基地局RBSからの距離、Gはレーダアンテナの利得、θはレーダアンテナのビーム幅、Dtrは無線LANシステムRSMのトラヒック密度（時間率／単位面積）である。

【0029】

【数1】

$$P = \int_{L=L\min}^{L=L\max} dP$$

$$= p_0 \cdot (\lambda / 4\pi)^2 \cdot G \cdot Dtr \cdot \theta \cdot \ln(L\max / L\min)$$

ただし、ln（ ）は自然対数。具体的な数値例を以下に示す。

G＝3000（＝34．8dB）

$\theta = (4\pi / G)^{1/2}$

よって

$G\theta = (4\pi G)^{1/2}$

＝1．94e2

Dtr＝5e－6

ただし、無線LANシステムの設置密度を1e－4／m^2（つまり平均100m四方に1システムの密度）、1システム当たりの平均トラヒック（時間率）を5e－2（対等分散形無線LANシステムの最大スループットの1／10程度）とした。

【0030】そうすると受信電力Pは、

$$P(\mathrm{dBm}) = p_o(\mathrm{dBm}) - 64.2 + 10\cdot\log(\ln(L_{max}/L_{min}))$$

となる。ただし、log（ ）は常用対数である。別無線チャネルで稼働している無線ＬＡＮシステムの送信出力を１０ｄＢｍ、つまりp_o＝１０ｄＢｍとするならば、

$$P = 54.2 + 10\cdot\log(\ln(L_{max}/L_{min}))\ (\mathrm{dBm})$$

となる。ここで、レーダのフロントエンドが混変調を起こさないための帯域外許容入力レベルを－５０ｄＢとすると、L_{max}/L_{min}は１３．９となる。地球の丸みに起因するレーダ波の最大到達距離を１００ｋｍとすると、L_{min}は７．２ｋｍとなる。１．２ＧＨｚ帯での自由空間損失は、１１１．２ｄＢであり、レーダパルス信号の最小出力レベル（ピーク）を＋８７ｄＢｍ、レーダのアンテナ利得を３５ｄＢ、無線ＬＡＮシステムの受信アンテナ利得を０ｄＢとすれば、L_{min}の距離におけるレーダパルス信号の受信レベルは、＋１０．８ｄＢｍとなる。もちろん、上記帯域外型許容入力レベルは、無線ＬＡＮシステムが無線チャネルを共用しようとするレーダシステムの仕様によるものである。

【００３１】以上の数値計算により求めた＋１０．８ｄＢｍを、第２のキャリア検出レベルＣＳＬ２として設定すれば、レーダシステムＲＳＭが使用中の無線チャネルに対し近接した無線チャネルを使用している無線ＬＡＮシステムからの無線信号が、レーダ基地局ＲＢＳのフロントエンドで混変調による干渉を引き起こすことを回避することが可能である。実際の無線通信装置への実装にあたっては、第２のキャリア検出レベルＣＳＬ２の設定精度などに基づき適切なマージンが設定されることを言うまでもない。具体的には、例えば３ｄＢのマージンを見込むと、第２のキャリア検出レベルＣＳＬ２は＋７．８ｄＢｍになる。

【００３２】一方第３のキャリア検出回路３４は、ＣＳＭＡ（carrier sense multiple access ）方式によるパケットデータの無線送信を行なうために、無線ＬＡＮシステム内の他の無線通信端末装置ＴＵから送信された被変調搬送波信号を検出するためのもので、受信搬送波信号のレベルを予め設定された第３のキャリア検出レベルＣＳＬ３と比較する。そして、この第３のキャリア検出レベルＣＳＬ３よりもレベルの大きい受信搬送波信号が検出されている期間に、第３の検出信号ＣＳＳ３を発生してアクセスコントローラ２３に供給する。

【００３３】ここで、上記第３のキャリア検出レベルＣＳＬ３は、次のように設定される。すなわち、いま仮に利用周波数帯を１．２ＧＨｚ帯とするとともに、自由空間損失（距離４０ｍ）を６０ｄＢｍ、受信電力（距離４０ｍ）を－６２ｄＢｍとする。また、バンド幅Ｂを２．５Mbaud、ノイズ指数Ｆを６ｄＢとすると、熱雑音は

$$k\times T\times B\times F = -104\,\mathrm{dBm}$$

となる。ただし、ｋはボルツマン定数、Ｔは温度である。以上の条件から、無線ＬＡＮシステム内の他の無線通信端末装置ＴＵから到来する無線信号を検出するためのキャリア検出レベルＣＳＬ２は、熱雑音で誤動作せず、かつフェージングがあっても他の無線通信装置からの無線信号の存在を極力検出するために、例えば

－８４ｄＢｍ（熱雑音＋２０ｄＢｍ）

に設定する。ところで、アクセスコントローラ２３には、レーダ使用判定部２３ｃと、レーダ干渉判定部２３ｄと、無線アクセス制御部２３ｅとが設けられている。レーダ使用判定部２３ｃは、上記第１のキャリア検出回路３２から出力された第１の検出信号ＣＳＳ１を基に、レーダシステムＲＳＭの稼働の有無を検出するものである。

【００３４】なお、この無線ＬＡＮシステムにおいて、無線通信装置間の距離が非常に近い場合、例えば１ｍの間隔で自システムの２台の無線通信装置が存在する場合には、自由空間損失が３４ｄＢとなることから、無線チャネル１キャリア当たりの受信レベルは、－３０ｄＢｍとなる。この場合は、先に述べた第１のキャリア検出レベルＣＳＬ１の設定値を越えることからレーダパルス信号と誤判定されることになる。

【００３５】そこで、レーダパルス信号の到来の有無をさらに正確に判定するために、アクセスコントローラ２３のレーダ判定部２３ｃは図３に示す如く構成される。すなわち、第１のキャリア検出回路３２から出力された第１の検出信号ＣＳＳ１は、バッファ増幅器４１を介して第１のセレクタ４４、第２のセレクタ４６およびパルス長判定回路４２にそれぞれ入力される。パルス長判定回路４２は、一般にレーダパルス信号の信号長は１～１０μsec 程度と非常に短いのに対し、パケットデータ長は最短でも５０μsec になることに着目して、上記第１の検出信号ＣＳＳ１がパケットデータを検出したものかまたはレーダパルス信号を検出したものかを判定するもので、例えばカウンタと判定部とから構成される。カウンタでは、上記第１の検出信号ＣＳＳ１のパルス幅Ｔが検出される。判定部では、上記カウンタにより検出されたパルス幅Ｔが、レジスタ４３ａ，４３ｂに予め記憶されている最大パケットデータ長T_{max}および最短パケットデータ長T_{min}と各々比較される。そして、その比較結果が

$$T < T_{min} \text{ かまたは } T > T_{max}$$

の条件を満たすか否かを表わす判定信号ＰＳＳが出力される。

【００３６】第１のセレクタ４４は、レジスタ４５に記憶されているセレクト指示情報に従って、第１の検出信号ＣＳＳ１と、上記パルス長判定回路４２から出力されたパルス長検出信号との一方を選択して出力するもので、この選択出力された検出信号は周期信号検出回路５０に入力される。周期信号検出回路５０は、一般にパケットデータはランダムに送信されるため周期性を有していないのに対し、レーダパルス信号を明確な周期性を有

していることに着目して、上記検出信号がパケットデータを検出したものかまたはレーダパルス信号を検出したものかを判定するもので、この周期信号検出回路５０から出力された周期性の有無を表わす判定信号ＩＳＳは第２のセレクタ４６に入力される。

【００３７】第２のセレクタ４６では、レジスタ４７に記憶されているセレクト指示情報に従って、上記第１のキャリア検出回路３２から出力された第１の検出信号ＣＳＳ１と、上記パルス長判定回路４２から出力されたパルス長判定信号ＰＳＳと、上記周期信号検出回路５０から出力された周期性の有無を表わす周期性判定信号ＩＳＳとのうちの一つが選択されて段数保護回路４８に供給される。

【００３８】段数保護回路４８では、上記第２のセレクタ４６から選択出力される検出信号ＣＳＳ１または判定信号ＩＳＳの出力回数が一定時間ごとに計数され、この計数値がレジスタ４９ａに記憶されている後方保護回数を上回った場合に、レーダシステムＲＳＭが無線チャネルｆ１～ｆ４の使用を開始したことを表わす検出情報が発生される。また、レーダ使用検出中においては、上記計数値がレジスタ４９ｂに記憶されている前方保護回数を下回った場合に、レーダシステムＲＳＭが無線チャネルｆ１～ｆ４の使用を停止したことを表わす検出情報が発生される。検出フラグレジスタ５１は、上記各検出情報に応じて、レーダシステムＲＳＭによる無線チャネルｆ１～ｆ４の使用状態を表わす検出フラグをセット／リセットする。

【００３９】レーダ干渉判定部２３ｄは、前記第２のキャリア検出回路３３から出力された第２の検出信号ＣＳＳ２を基に、レーダシステムＲＳＭに対し混変調による干渉を生じさせる可能性があるか否かを判定する。そして、その判定結果を無線アクセス制御部２３ｅに供給する。

【００４０】無線アクセス制御部２３ｅは、前記レーダ使用判定部２３ｃによる判定結果と、上記レーダ干渉判定部２３ｄによる判定結果とに基づいて、無線チャネルの使用の有無を最終的に決定する。そして、レーダシステムＲＳＭに対し同一無線チャネルの干渉および異なる無線チャネルによる混変調を起こさせることなく無線チャネルを使用が可能であると判定した状態で、端末装置本体１０のＣＰＵ１１からデータパケットの送信要求が到来すると、第３のキャリア検出回路３４から出力される第３の検出信号ＣＳＳ３を基に、ＣＳＭＡ方式に従って無線チャネルをアクセスし、パケットデータの送受信を行なわせる。

【００４１】次に、以上のように構成された装置の動作を説明する。無線ＬＡＮシステムが稼働を開始する際に、各無線通信装置は電源投入後、各装置ごとに予め異ならせて設定された時間が経過した後に、自装置が仮親局である旨の宣言を行なうための信号をシステム内の他の無線通信装置へ送出する。また各無線通信装置は、上記宣言信号を送出するまでの時間内に他の無線通信装置からの宣言信号の到来を監視し、自装置が宣言信号を送出する前に他の装置から宣言信号が到来すると、この宣言信号を送出した無線通信装置を仮親局として認定し以後この仮親局の指示に従う。すなわち、宣言信号を最も早く送出した無線通信装置が仮親局となる。

【００４２】さて、仮親局となった無線通信装置ＴＵは、先ず自己のシステムで使用可能な複数の無線チャネルを順にサーチしてその無線信号を受信し、これにより各無線チャネルごとにレーダシステムＲＳＭがこの無線チャネルを使用しているか否かを判定する。

【００４３】すなわち、各無線チャネルにより伝送された無線搬送波信号は、アンテナ２７で受信されたのち低雑音増幅器２９および帯域通過フィルタ３０を介して第１のキャリア検出回路３２に入力される。この第１のキャリア検出回路３２では、上記無線搬送波信号の受信レベルが、予め設定されている第１のキャリア検出値ＣＳＬ１（－４７ｄＢｍ）以上であるか否かが検出され、その検出信号がアクセスコントローラ２３のレーダ使用判定部２３ｃに入力される。

【００４４】いま仮に、レーダ使用判定モードが第１の検出信号ＣＳＳ１のみを用いて判定するモードに設定されていたとする。そうすると、レーダ使用判定部２３ｃにおいて、第２のセレクタ４６は上記第１の検出信号ＣＳＳ１を選択出力する状態に設定されているため、段数保護回路４８には上記第１の検出信号ＣＳＳ１が入力される。段数保護回路４８では、上記第１の検出信号ＣＳＳ１の発生回数が一定期間内に予め設定された後方保護回数を上回ったか否かが判定されている。

【００４５】この状態で、いま例えばレーダシステムＲＳＭが無線チャネルｆ１～ｆ４を使用してレーダサーチを行なっていたとする。そうすると、上記第１のキャリア検出回路３２からは、レーダ基地局ＲＢＳから送信されたレーダパルス信号が受信されるごとに第１の検出信号ＣＳＳ１が出力される。このため、第１の検出信号ＣＳＳ１の発生回数は一定期間内に後方保護回数を上回ることになり、この結果上記段数保護回路４８からはレーダ使用中であることを示す検出情報が出力されて、レジスタ５１の検出フラグがセットされる。

【００４６】これに対し、レーダシステムＲＳＭが無線チャネルｆ１～ｆ４以外の無線チャネルを使用してレーダサーチを行なっていたとする。この場合には、無線チャネルｆ１～ｆ４においてレーダパルス信号は受信されないため、第１のキャリア検出回路３２からは第１の検出信号ＣＳＳ１は出力されない。このため、レーダ使用判定部２３ｃの段数保護回路４８では、第１の検出信号ＣＳＳ１の発生回数が一定期間内に後方保護回数を上回ることはなく、したがってレジスタ５１の検出フラグはリセット状態を保持する。

【0047】また、レーダシステムＲＳＭが使用チャネルを無線チャネルｆ１～ｆ４から他の無線チャネルに切り替えた場合には、第１のキャリア検出回路３２からの第１の検出信号ＣＳＳ１の出力は途絶える。このため、レーダ使用判定部２３ｃの段数保護回路４８では、第１の検出信号ＣＳＳ１の発生回数が一定期間内に前方保護回数を下回ることになり、この結果段数保護回路４８からはレーダシステムＲＳＭが無線チャネルｆ１～ｆ４を使用していないことを示す検出情報が出力され、これによりレジスタ５１の検出フラグはリセットされる。

【0048】また、上記仮親局となった無線通信装置ＴＵは、上記レーダシステムＲＳＭによる各無線チャネルの使用の有無の判定とともに、隣接する無線チャネルを使用して無線送信を行なった場合にレーダシステムＲＳＭが混変調による干渉を起こすか否かを判定する。

【0049】すなわち、各無線チャネルにより伝送された無線搬送波信号は、アンテナ２７で受信されたのち低雑音増幅器２９および帯域通過フィルタ３０を介して第２のキャリア検出回路３３に入力される。この第２のキャリア検出回路３３では、上記無線搬送波信号の受信レベルが、予め設定されている第２のキャリア検出値ＣＳＬ２（＋１０．８ｄＢｍ）以上であるか否かが検出され、その検出信号がアクセスコントローラ２３のレーダ干渉判定部２３ｄに入力される。レーダ干渉判定部２３ｄでは、上記検出信号ＣＳＳ２に応じてレーダシステムＲＳＭに対し混変調による干渉を生じさせる心配がないか否かが判定され、その判定結果が無線アクセス制御部２３ｅに供給される。無線アクセス制御部２３ｅは、レーダシステムＲＳＭが使用していない無線チャネルが検出され、しかもこの無線チャネルに隣接する他の無線チャネルにより無線送信を行なってもレーダシステムＲＳＭに混変調による干渉を引き起こさせる心配はないと判定されると、上記無線チャネルをシステム内の各無線通信装置に使用チャネルとして指示する。

【0050】さて、この状態で端末装置本体１０においてオペレータがパケットデータの送信指示を入力したとする。そうすると、端末装置本体１０のＣＰＵ１１は、先ずアクセスコントローラ２３のレーダ使用判定部２３ｃにおける検出フラグ５１の状態を判定する。そして、検出フラグ５１の状態がリセット状態、つまりレーダシステムＲＳＭが無線チャネルｆ１～ｆ４を使用していないことを表わす状態になっていることを確認すると、無線ＬＡＮアダプタ２０のバッファメモリ２２にバスインタフェース２１を介して送信パケットデータを書き込み、アクセスコントローラ２３にパケットデータの送信を指示する。

【0051】この指示を受けてアクセスコントローラ２３は、先ず無線アクセス制御部２３ｄにおいて、第２のキャリア検出回路３３の検出信号ＣＳＳ２を基に、無線ＬＡＮシステムの他の無線通信端末装置ＴＵが無線チャネルｆ１～ｆ４を使用してパケットデータの送信を行なっているか否かを判定する。この判定により、どの無線通信端末装置ＴＵも送信を行なっていないと判定されると、次に送信制御部２３ａから変調回路２４へ送信パケットデータＴＤおよび送信クロックＴＣＫを送出するとともに、キャリアスイッチ信号ＣＳＷを送出する。このため、変調回路２４は搬送波信号を送出可能な状態となり、以後上記送信パケットデータＴＤにより変調された４波の被変調搬送波信号の送信を開始する。なお、上記無線アクセス制御部２３ｄにおいて、無線チャネルｆ１～ｆ４が既に他の無線通信端末装置ＴＵにより使用されていると判定された場合には、無線アクセス制御部２３ｄから送信制御部２３ａへは送信許可が与えられず、この結果送信パケットデータの送信は行なわれない。

【0052】これに対し、上記レーダ使用判定部２３ｃの検出フラグ５１がセット状態に、つまりレーダシステムＲＳＭが無線チャネルｆ１～ｆ４を使用中であることを表わす状態になっている場合には、無線アクセス制御部２３ｄによりレーダシステムＲＳＭが使用していない他の無線チャネルがサーチされる。そして、この他の無線チャネルが見つかると、使用すべき無線チャネルをこの無線チャネルに変更（ハンドオフ）するための制御が行なわれる。このハンドオフ制御は、例えば無線ＬＡＮシステム内の任意の無線通信端末装置ＴＵが一時的に仮親局となり、この仮親局がシステム内の他の無線通信端末装置ＴＵに対しハンドオフ指令を送出することにより行なわれる。

【0053】一方、無線通信端末装置ＴＵがパケットデータを送信している期間中に、レーダシステムＲＳＭが無線チャネルを無線ＬＡＮシステムが使用している無線チャネルｆ１～ｆ４に切り替えたとする。そうすると、この場合にはレーダ基地局ＲＢＳから送信されたレーダパルス信号の受信に応じて、第１のキャリア検出回路３２から第１の検出信号ＣＳ１が出力される。そして、この第１の検出信号ＣＳＳ１の発生回数の累計値が一定期間内に後方保護回数を上回ると、その時点でレーダ使用判定部２３ｃの検出フラグレジスタ５１がセット状態に変化する。つまり、検出フラグは、レーダシステムＲＳＭにより無線チャネルｆ１～ｆ４が使用中であることを表わす状態となる。この検出フラグ５１の変化は無線アクセス制御部２３ｄにより検出され、これに応じて送信制御部２３ａはパケットデータの送信を即時中止する。したがって、無線ＬＡＮシステムによるレーダシステムＲＳＭの干渉妨害は防止される。なお、この送信中止後に無線通信端末装置ＴＵは先に述べたハンドオフ制御を行なってもよい。

【0054】ところで、無線通信端末装置ＴＵがパケットデータの送信を行なっている期間中に、何らかの原因でこの無線搬送波信号を検出できずに、比較的近接して配置されている他の無線通信端末装置ＴＵがパケットデ

ータの送信を開始したとする。この場合、上記パケットデータ送信中の無線通信端末装置ＴＵでは、－５７ｄＢｍ以上の無線搬送波信号が受信されるので、第１のキャリア検出回路３２からは第１の検出信号ＣＳＳ１が出力される。つまり、レーダパルス信号ではなく送信パケットデータの無線搬送波信号が受信されたにも拘らず、レーダパルス信号が検出されたことを表わす検出信号が発生される。このため、レーダ使用判定部２３ｃではレーダシステムＲＳＭにより無線チャネルｆ１～ｆ４の使用が開始されたものと判定され、これに応じて送信制御部２３ａによるパケットデータの送信は中止される。すなわち、パケットデータの送信を中止する必要がないにも拘らず、送信を中止してしまうことになる。

【００５５】このような事態を回避するためには、端末装置本体１０によりレーダ使用判定部２３ｃのレジスタ４７のセレクト指示情報を書き替え、これにより第２のセレクタ４６においてパルス長判定回路４２から出力されたパルス長判定信号ＰＳＳが選択されるようにする。そうすると、段数保護回路４８にはパルス長判定回路４２から出力された判定信号ＰＳＳが供給され、これにより段数保護回路４８では上記判定信号ＰＳＳの発生回数に基づいて検出フラグ５１の状態を変化させることになる。ここで、上記パルス長判定回路４２は、第１の検出信号ＣＳＳ１のパルス幅が、最短パケットデータ長（５０μsec ）よりも短いかまたは最長パケットデータ長よりも長い場合にのみ判定信号ＰＳＳを出力する。このため、たとえ第１のキャリア検出回路３２から第１の検出信号ＣＳＳ１が発生されても、そのパルス幅がパケットデータ長に対応する場合には判定信号ＰＳＳは出力されず、レーダパルス信号（パルス長１～１０μsec ）のようにパルス信号長が最短パケットデータ長よりも短い場合に判定信号ＰＳＳが出力される。このため、段数保護回路４８では、上記パルス長判定信号ＰＳＳの発生回数に応じて、レーダシステムＲＳＭが無線チャネルｆ１～ｆ４を使用中か否かを表わす検出フラグ５１が制御されることになる。したがって、受信レベルの大きいパケットデータをレーダパルス信号であると誤認識して、パケットデータの送信を停止させてしまう事態は回避される。

【００５６】一方、以上の説明では第１のキャリア検出回路３２に設定したキャリア検出レベルＣＳＬ１を－５７ｄＢｍとしたが、このような高い検出レベルであると、確かに無線ＬＡＮシステムからレーダシステムＲＳＭへの干渉は防止されるが、レーダシステムＲＳＭから無線ＬＡＮシステムへの干渉は防止されない。すなわち、レーダパルス信号の受信レベルが－５７ｄｍ未満だからといって、その受信レベルによっては受信パケットデータに干渉を与えることが十分にありうる。この不具合を低減するためには、第１のキャリア検出レベルＣＳＬ１を例えば熱雑音＋１０ｄＢｍ（－９４ｄＢｍ）程度のより小さい値に設定すればよい。しかし、このようにするとレーダパルス信号ばかりでなく、隣接する他の無線ＬＡＮシステムから到来する無線信号も検出してしまうことになり、レーダパルス信号を他の無線ＬＡＮシステムからの無線信号と判別して検出することが必要となる。

【００５７】その検出手段としては、先に述べたパルス長判定回路４２を用いることも有効である。しかし、レーダパルス信号の信号長と最短パケットデータ長とがほぼ同じだったりまた差はあっても大きな差ではない場合には、上記パルス長判定回路４２では正確な判定を行なうことが難しくなる。

【００５８】そこで、このような場合に対処するためには、レーダ使用判定部２３ｃに設けた周期信号検出回路５０を用いることが有効である。すなわち、端末装置本体１０によりレーダ使用判定部２３ｃのレジスタ４７のセレクト指示情報を書き替え、これにより第２のセレクタ４６において周期信号検出回路５０から出力された判定信号ＩＳＳが選択されるように設定する。そうすると、段数保護回路４８には周期信号検出回路５０から出力された判定信号ＩＳＳが供給されることになり、段数保護回路４８はこの周期信号の判定信号ＩＳＳに基づいて検出フラグ５１の状態を変化させることになる。ここで、先に述べたように一般にパケットデータはランダムに送信されるため周期性を有していないのに対し、レーダパルス信号を明確な周期性を有している。そして、この点に着目して上記周期信号検出回路５０は、第１の検出信号ＣＳＳ１またはパルス長判定回路４２の判定信号ＰＳＳが、パケットデータを検出したものかまたはレーダパルス信号を検出したものかを判定している。このため、たとえ第１のキャリア検出回路３２から第１の検出信号ＣＳＳ１が発生されても、またパルス長判定回路４２から判定信号ＰＳＳが発生されても、これらの検出信号ＣＳＳ１または判定信号ＰＳＳが周期性を有する信号でなければ、上記周期信号検出回路５０からは判定信号ＩＳＳは発生されない。したがって段数保護回路４８では、上記周期信号検出回路５０から出力された判定信号ＩＳＳ、つまりレーダパルス信号であることをより明確に表わす判定信号の発生回数に応じて、レーダシステムＲＳＭが無線チャネルｆ１～ｆ４を使用中か否かを表わす検出フラグ５１が制御されることになる。このため、レーダパルス信号と受信レベルおよび信号長がほぼ等しい他の無線ＬＡＮシステムのパケットデータをレーダパルス信号として誤判定する不具合は低減され、これによりパケットデータの送信を安定に行なうことが可能となる。

【００５９】以上述べたように本実施例では、無線通信端末装置ＴＵに、ＣＳＭＡ方式にしたがって無線パケット伝送を行なうために必要な第３のキャリア検出回路３４とは別に、第１のキャリア検出回路３２およびレーダ

使用判定部２３ｃを設け、第１のキャリア検出回路３２によりキャリア検出レベルＣＳＬ１よりも受信レベルの大きい無線搬送波信号を検出し、かつその検出信号ＣＳＳ１を基にレーダ使用判定部２３ｃにおいてレーダシステムＲＳＭが無線チャネルを使用しているか否かを判定している。そして、レーダシステムＲＳＭが無線チャネルを使用中であると判定した場合には、この無線チャネルによるパケットデータの送信を行なわないようにしている。

【００６０】また本実施例の無線通信装置ＴＵでは、第２のキャリア検出回路３３およびレーダ干渉判定部２３ｄを備え、これらの回路により自己のシステムが使用中の無線チャネル以外の無線チャネルを使用して無線信号を送信した場合であってもレーダシステムＲＳＭに混変調を与える可能性があるか否かを判定し、混変調を与える可能性がある場合にはすべての無線チャネルの使用を禁止するようにしている。このため、レーダシステムＲＳＭに対し混変調による干渉妨害を与える不具合は確実に防止される。

【００６１】したがって本実施例によれば、既存のレーザシステムの無線エリア内で同じ無線チャネルを使用してパケットデータの無線伝送を行なうにも拘らず、レーザシステムＲＳＭに対し干渉妨害など悪影響を与えることなく無線ＬＡＮシステムを稼働することができる。すなわち、準マイクロ波帯のように新たな無線通信システムに割り当て可能な周波数が残っていない周波数帯であっても、無線ＬＡＮシステムを運用することができる。

【００６２】また本実施例では、レーダシステムＲＳＭによる無線チャネルの使用の有無を判定するための手段として、受信レベルを判定する第１のキャリア検出回路３２に加えて、パルス長判定回路４２を設け、このパルス長判定回路４２の判定信号ＰＳＳを基にレーダシステムＲＳＭによる無線チャネルの使用の有無を判定できるようにしている。したがって、受信レベルの大きい受信パケットデータをレーダパルス信号であると誤認識する不具合は低減され、これによりパケットデータの送信を不必要に停止させてしまう事態は回避される。

【００６３】さらに本実施例では、レーダシステムＲＳＭによる無線チャネルの使用の有無を判定するための手段として、周期信号検出回路５０を新たに設け、受信レベルを判定する第１のキャリア検出回路３２の検出信号ＣＳＳ１、またはパルス長判定回路４２の判定信号ＰＳＳを上記周期信号検出回路５０に入力してその周期性の有無を判定し、この判定信号ＩＳＳを基にレーダシステムＲＳＭによる無線チャネルの使用の有無を判定できるようにしている。したがって、例えば第１のキャリア検出回路３２の検出レベルＣＳＬ１を低く設定した場合や、またレーダパルス信号の信号長と最短パケットデータ長との間に明確な差がない場合のように、受信レベルやパルス長によりレーザパルス信号を判定することが困難な場合でも、レーダシステムＲＳＭによる無線チャネルの使用の有無を正確に判定することができる。

【００６４】なお、本発明は上記実施例に限定されるものではない。例えば、上記実施例では、レーダシステムＲＳＭによる無線チャネルの使用の有無を判定するためのモードとして、

ａ．受信レベルの検出信号ＣＳＳ１のみを基に判定するモード。

ｂ．受信レベルの検出信号ＣＳＳ１とパルス長判定信号ＰＳＳとを基に判定するモード。

ｃ．受信レベルの検出信号ＣＳＳ１またはパルス長判定信号ＰＳＳと、その周期性の有無を表わす判定信号ＩＳＳとを基に判定するモード。を用いる場合について述べた。しかし、それ以外のモードとして、

ｄ．パルス長判定信号ＰＳＳのみを基に判定するモード。

ｅ．周期性の有無を表わす判定信号ＩＳＳのみを基に判定するモード。

を使用してもよい。

【００６５】また、以上のような各モードを選択的に使用する判定方法を、レーダシステムに混変調による干渉を与える可能性があるか否かを判定するために適用してもよい。また、その判定結果を無線通信装置に例えばＬＥＤやＬＣＤを用いて表示するように構成してもよい。

【００６６】さらに、前記実施例ではレーダシステムＲＳＭの無線チャネルを共用して無線ＬＡＮシステムを構築するようにした場合を例にとって説明したが、他にセルラ自動車・携帯電話システムや選択呼出通信システム、ＭＣＡシステム、構内移動無線通信システムなどと無線チャネルを共用して無線ＬＡＮシステムを構築するようにしてもよい。

【００６７】その他、第２の無線システムの種類や構成、無線通信装置の種類や構成、第１および第２の判定手段の構成、無線チャネル使用制御手段の構成や制御手順、送信パケットデータの送信手順等についても、本発明の要旨を逸脱しない範囲で種々変形して実施できる。

【００６８】

【発明の効果】以上詳述したように本発明の無線通信装置は、無線チャネルの状態を知るために第１の判定手段および第２の判定手段を備え、第１の判定手段により、上記無線チャネルを介して伝送された無線信号を受信してその受信結果に基づいて既存の第１の無線システムによる上記無線チャネルの使用状態を判定し、さらに第２の判定手段により、無線チャネルを介して伝送された無線信号を受信して、その受信結果に基づいて当該無線チャネル以外の無線チャネルを使用して無線信号を送信した場合であっても上記第１の無線システムに混変調を与える可能性があるか否かを判定している。そして、無線チャネル使用制御手段により、上記第１の判定手段で上記無線チャネルが使用中と見なせる状態にあると判定さ

れた場合には当該無線チャネルの使用を回避し、かつ上記第２の判定手段により上記第１の無線システムに混変調を与える可能性があると判定された場合にはすべての無線チャネルの使用を回避するための処理を実行するようにしたものである。

【００６９】したがって本発明によれば、既存の無線システムの無線エリア内において干渉妨害や混変調などの悪影響を及ぼすことなく無線通信を行なうことができ、これにより所望の周波数帯を利用して新たな無線通信システムを実現することができる無線通信装置を提供することができる。

【図面の簡単な説明】

【図１】本発明の一実施例に係わる無線通信システムの概略構成図。

【図２】図１に示したシステムの無線通信端末装置の構成を示す回路ブロック図。

【図３】図２に示した無線通信端末装置のレーダ使用判定部の構成を示す回路ブロック図。

【符号の説明】

ＲＳＭ…レーダシステム　ＲＢＳ…レーダ基地局

ＬＳＭ１～ＬＳＭ３…無線ＬＡＮシステム

ＴＵ１１～ＴＵ３４…無線通信端末装置

１０…端末装置本体　１１…ＣＰＵ

１２…メモリ　２０…無線ＬＡＮアダプタ

２１…バスインタフェース部　２２…バッファメモリ

２３…アクセスコントローラ部　２３ａ…送信制御部

２３ｂ…受信制御部　２３ｃ…レーダ使用判定部

２３ｄ…レーダ干渉判定部　２３ｅ…無線アクセス制御部

２４…変調回路（ＭＯＤ）

２５…送信電力増幅器　２６…サーキュレータ

２７…アンテナ　２８…高周波スイッチ

２９…低雑音増幅器　３０…帯域通過フィルタ

３１…復調回路　３２…第１のキャリア検出回路

３３…第２のキャリア検出回路　３４…第３のキャリア検出回路

４１…バッファ増幅器

４２…パルス長判定回路　４３ａ，４３ｂ…レジスタ

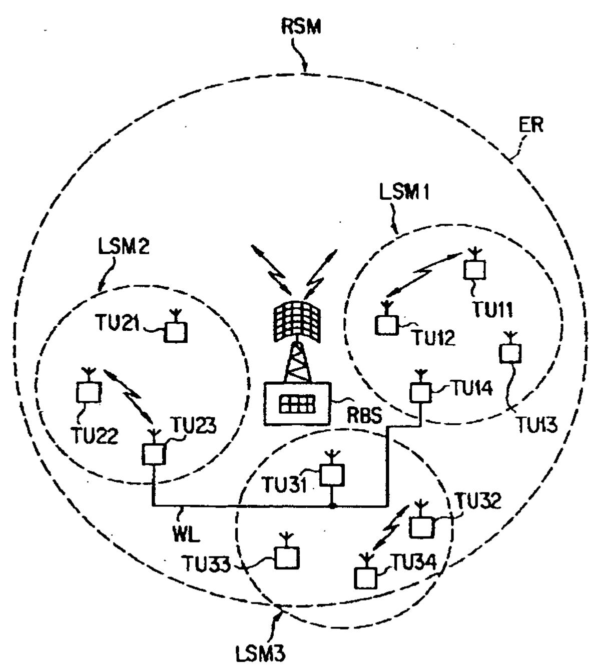
４４…第１のセレクタ　４５，４７…セレクト指示レジスタ

４６…第２のセレクタ　４８…段数保護回路

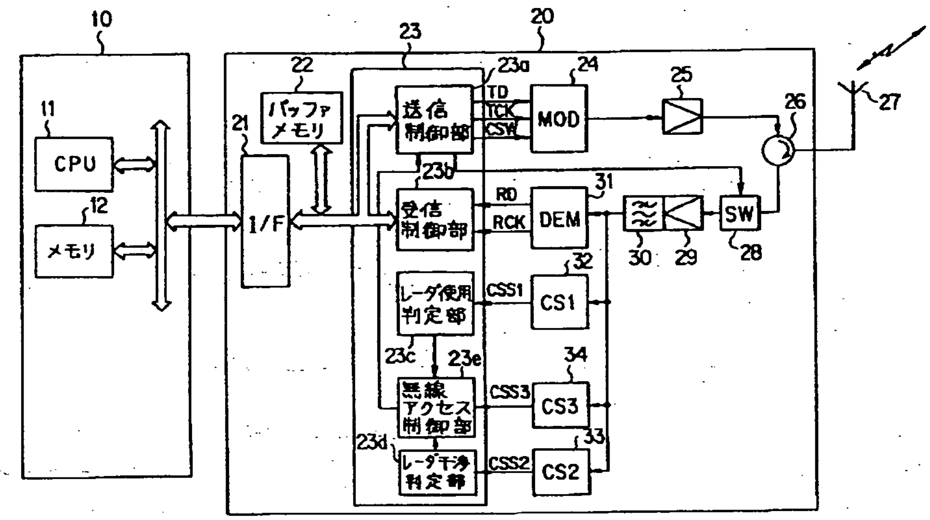
４９ａ，４９ｂ…保護回数レジスタ　５０…周期信号検出回路

５１…検出フラグレジスタ（検出フラグ）

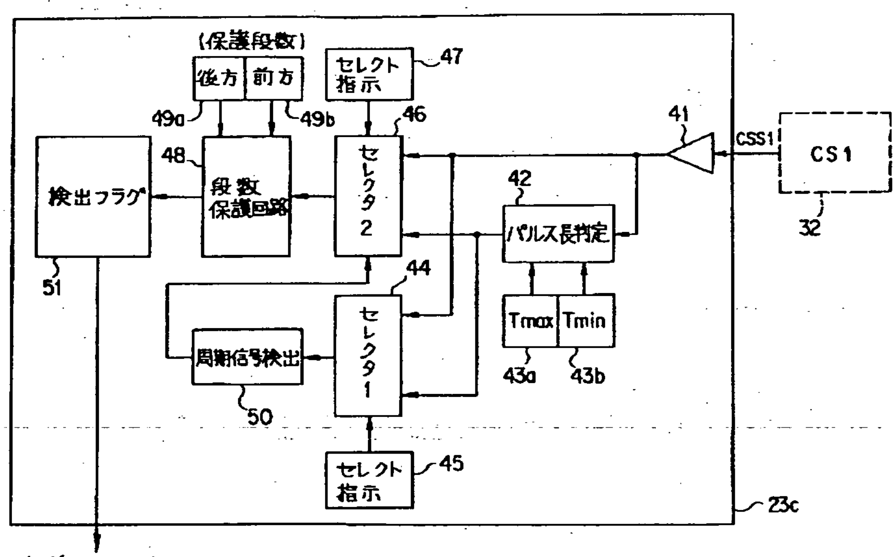
【図１】



【図2】


10
11
CPU
12
メモリ
20
21
I/F
22
バッファメモリ
23
23a
送信制御部
23b
受信制御部
レーダ使用判定部
23c
23e
無線アクセス制御部
23d
レーダ干渉判定部
TD
TCK
CSW
RD
RCK
CSS1
CSS3
CSS2
24
MOD
31
DEM
32
CS1
34
CS3
33
CS2
25
26
27
28
SW
29
30

【図3】


(保護段数)
後方
前方
49a
49b
セレクト指示
47
46
48
段数保護回路
検出フラグ
51
セレクタ2
41
CSS1
CS1
32
42
パルス長判定
44
セレクタ1
Tmax
Tmin
43a
43b
周期信号検出
50
セレクト指示
45
23c
無線アクセス制御部 23d へ

* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] In the radio communication equipment used by the 2nd wireless system which shares the 1st wireless system and radio channel which use a specific radio channel alternatively out of two or more radio channels, and performs radio The 1st judgment means for receiving the radio signal transmitted through the radio channel chosen among said two or more radio channels, and judging the busy condition of the radio channel concerned by said 1st wireless system based on the receiving result, The radio signal transmitted through said selected radio channel is received. The 2nd judgment means for judging whether based on the receiving result, even if it is the case where a radio signal is transmitted using radio channels other than the radio channel concerned, cross modulation may be given to said 1st wireless system, When judged with it being in the condition that said selected radio channel can regard it as under use by said 1st wireless system said 1st judgment means, while avoiding use of the radio channel concerned The radio communication equipment characterized by providing the radio-channel use control means which performs processing for avoiding use of said all radio channels when judged with cross modulation being given to said 1st wireless system with said 2nd judgment means.

[Claim 2]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the radio communication equipment used in order to share the radio channel in the wireless area of the wireless system of especially existing, such as a radar system, and to perform radio with respect to the radio communication equipment used with radio communications systems, such as a wireless LAN (local area netwoak) system.
[0002]
[Description of the Prior Art] In recent years, various radio communications systems are advocated with increase of communication link needs, or progress of a radio technique, and a wireless LAN system is in one of them. This wireless LAN system carries out the radio transmission of the data in service areas limited comparatively, such as an office building and a place of business, between [, such as a host computer, a personal computer, a printer, and electronic file equipment] terminal units.
[0003] By the way, as a data transmission rate of this kind of system, he is IEEE802.3, for example. The rate of 10 or more Mbpses is wished that it is represented by CSMA/CD, and in order to realize this transmission speed, the bandwidth of dozens of MHz or more is needed. Moreover, since the silicon device is available because of that free space loss is small for power consumption reduction of radio equipment as a frequency band in the case of realizing this kind of wireless LAN system, and cheap-izing of radio equipment, a semi- microwave band 3GHz or less is suitable. However, the actual condition is that there is no room to be ending and newly assign [most frequencies assign other existing systems, and] a band dozens of MHz or more with a semi- microwave band for a wireless LAN system.
[0004]
[Problem(s) to be Solved by the Invention] Even if it is going to realize a new radio communications system like a wireless LAN system as mentioned above, the present condition is that there is no suitable available frequency band, and it is in a difficult situation to realize a new radio communications system for this reason.
[0005] It is offering the radio communication equipment which this invention's was made paying attention to the above-mentioned situation, the place made into the purpose enables it to perform radio, without doing bad influences, such as interference active jamming and cross modulation, to the existing wireless system, and can realize a new radio communications system by this using a desired frequency band.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose the radio communication equipment of this invention In order to know the condition of a radio channel, it has the 1st judgment means and the 2nd judgment means. With the 1st judgment means The radio signal transmitted through the above-mentioned radio channel is received, and the busy condition of the above-mentioned radio channel by the 1st existing wireless system is judged based on the receiving result. Further with the 2nd judgment means The radio signal transmitted through the radio channel was received, and even if it is the case where a radio signal is transmitted using radio channels other than the radio channel concerned based on the receiving result, it has judged whether cross modulation may be given to the wireless system of the above 1st. And it is made to perform the

processing for avoiding use of the radio channel concerned, when judged with it being in the condition that it can be regarded as under use of the above-mentioned radio channel with the judgment means of the above 1st, by the radio-channel use control means, and avoiding use of all radio channels, when judged with cross modulation being given to the wireless system of the above 1st with the judgment means of the above 2nd.

[0007] Moreover, while this invention compares with the 1st predetermined threshold level the signal level of the radio signal transmitted through the selected radio channel in the 1st judgment means with a comparison means A detection means detects either [at least] the signal length of the radio signal by which transmission was carried out [above-mentioned], or the periodicity of a signal. It is characterized also by using alternatively the signal length by the comparison result of the signal level by the above-mentioned comparison means, and the above-mentioned detection means, or the detection result of the periodicity of a signal, and judging the existence of use of the radio channel concerned by the 1st wireless system.

[0008] The 1st threshold level of the above is good in that case to set up so that the radio signal which self-equipment transmitted may be received with predetermined allowances to the minimum receiving sensitivity level assumed by the wireless system of the above 1st.

[0009] Furthermore, while this invention compares the signal level of the radio signal transmitted through the selected radio channel in the 2nd judgment means with the 2nd different predetermined threshold level and different predetermined comparison means from the 1st threshold level of the above A detection means detects either [at least] the signal length of the radio signal by which transmission was carried out [above-mentioned], or the periodicity of a signal. It is characterized also by judging whether the signal length by the comparison result of the signal level by the above-mentioned comparison means and the above-mentioned detection means or the detection result of the periodicity of a signal is used alternatively, and there is any possibility of giving cross modulation to the wireless system of the above 1st.

[0010] The 2nd threshold level of the above is good in that case to set up so that the radio signal which self-equipment transmitted may be received by the wireless system of the above 1st with predetermined allowances to the minimum received signal level assumed to cause cross modulation.

[0011]

[Function] As a result of judging the busy condition of a radio channel with the 1st judgment means, when it can be considered as a result according to this invention that the 1st existing wireless system is using this radio channel, the radio which used this radio channel is avoided. For this reason, it is the existing wireless system and common wireless area, and in spite of using a common radio channel, it becomes possible to employ the 2nd new wireless system, without having bad influences, such as interference active jamming, on the existing wireless system.

[0012] Moreover, when are judged with the 1st wireless system not using the radio channel and self-equipment is located near the radio communication equipment of the 1st wireless system, interference by cross modulation may occur in the radio communication equipment of the 1st wireless system by wireless transmission of self-equipment. However, in this invention, if it is judged with cross modulation being given to the 1st wireless system even if it is the case where a radio signal is transmitted using radio channels other than the radio channel concerned, as a result of judging the condition of a radio channel with the 2nd judgment means, use of all radio channels will be avoided. For this reason, the fault which causes the interference active jamming by cross modulation to the 1st existing wireless system is prevented certainly.

[0013] Therefore, according to this invention, it becomes possible to realize easily new radio communications systems, such as a wireless LAN system, using frequency bands, such as a semi-microwave band which cannot newly assign a frequency.

[0014] Moreover, when it is judged whether it is in the condition that it can be regarded as under use of a radio channel by the 1st wireless system, in this invention, And in case cross modulation may be given to the 1st wireless system or the country is judged, while judging the received signal level of a radio signal Either [at least] signal length or the periodicity are detected, and it is judging, using alternatively the judgment result of such receiving level and signal length, or the detection result of periodicity. For this reason, when the equipment with which the 1st wireless system sends out the radio signal which has high peaking capacity level like for example, a broader-based radar system,

and sends out radio signals other than the 1st wireless system does not exist in point-blank range, it becomes possible to judge the busy condition of the radio channel by the 1st wireless system only with the received signal level of a radio signal. Moreover, even when the equipment which sends out radio signals other than the 1st wireless system to point-blank range exists, by detecting the signal length or periodicity of a radio signal, the effect of the radio signal of systems other than the 1st wireless system is reduced, and it becomes possible more to judge stability and the busy condition of a radio channel according to the 1st wireless system certainly, without this causing an incorrect judging.
[0015]
[Example] This invention is explained based on an example below.
[0016] Drawing 1 is the schematic diagram showing the arrangement relation between the wireless LAN system concerning one example of this invention, and the existing radar system.
[0017] A radar system RSM has one radar base station RBS, and the radar wireless area ER according to the transmitted power of the radar base station RBS is formed in the predetermined field centering on this radar base station RBS. In this radar wireless area ER, two or more wireless LAN systems (drawing three systems) LSM1-LSM3 are installed. These wireless LAN systems LSM1-LSM3 are wireless LAN systems called the so-called equal distributed type, and have held two or more radio terminal units TU11-TU14, TU21-TU23, and TU31-TU34, respectively. A distributed type equal wireless LAN system is a system which it does not have a centralized-control station in a system, but each radio terminal unit performs control for a communication link autonomously respectively, and performs direct wireless data transmission between radio terminal units. Connection between each wireless LAN systems LSM [LSM1-] 3 is made by connecting the radio terminal units TU14, TU23, and TU31 of the arbitration in a system through a wire circuit WL.
[0018] By the way, each radio terminal units TU11-TU14, TU21-TU23, and TU31-TU34 (TU is called henceforth) are what used a host computer, a personal computer, a printer, or electronic file equipment as the body of a terminal unit, for example, they are constituted as follows. Drawing 2 is the circuit block diagram showing the important section configuration. That is, the radio terminal unit TU consists of a body 10 of a terminal unit, and a wireless LAN adapter 20 attached to this body 10 of a terminal unit. The terminal body 10 has packet data origination, such as CPU11 and memory 12, and a configuration required for storage.
[0019] The wireless LAN adapter 20 is equipped with the bus interface (I/F) 21 for performing packet data transfer between the above-mentioned bodies 10 of a terminal unit, and after the transmitting packet data transmitted from the body 10 of a terminal unit through this bus interface 21 are stored in buffer memory 22 temporarily, they are inputted into transmission-control section 23a of an access controller 23. Transmission-control section 23a of an access controller 23 will supply this transmitting packet data TD and a transmit clock TCK to a modulation circuit (MOD) 24 with the carrier switch signal CSW, if the above-mentioned transmitting packet data TD are inputted.
[0020] A modulation circuit 24 performs error correcting code-ized processing to the above-mentioned transmitting packet data SD first. And this error-correcting-code-ized transmitting packet data TD is trichotomized, and it inputs into three different modulators. These modulators modulate the subcarriers f1-f3 which are three from which a frequency differs according to the transmitting packet data by which trichotomy was carried out [above-mentioned], respectively. Moreover, a modulation circuit 24 generates parity information based on each transmitting packet data by which trichotomy was carried out [above-mentioned], and inputs this parity information into other modulators. This modulator modulates the 4th subcarrier f4 according to the above-mentioned parity information. After the modulated-carrier signal outputted from these four modulators is compounded, it is inputted into the transmitted power amplifier 26. The transmitted power amplifier 25 amplifies the above-mentioned 4 wave composition modulated-carrier signal to the transmission level to which it was specified by the system. At this time, a transmission level is set for example, as 2.5mW / carrier. For this reason, the modulated-carrier signal which compounded four waves as mentioned above is set to a total of 10mW, and is outputted. 4 wave composition modulated-carrier signal outputted from this transmitted power amplifier 25 is supplied to an antenna 27 through a circulator 26, and wireless transmission is carried out towards other radio terminal units TU in a system from this antenna 27. In addition, the above-mentioned carrier switch signal CSW is a signal

for preventing the output of the modulated-carrier signal from a modulation circuit 24 at the period which does not need to transmit a subcarrier.

[0021] On the other hand, after 4 wave composition modulated-carrier signal received with the antenna 27 passes through a circulator 26 and the high frequency switch (SW) 28, the sequential input of it is carried out at a low noise amplifier 29 and a band-pass filter 30. In a low noise amplifier 29, the radio signal by which reception was carried out [above-mentioned] is amplified by signal level required for recovery processing. Only the radio frequency component of a predetermined band is extracted in a band-pass filter 30. In addition, the high frequency switch 28 was formed in order to prevent that the transmitting radio signal reflected with the antenna 27 at the time of transmission turns to a receiving system, and only a receiving period flows through it according to the control signal outputted from an access controller 23.

[0022] 4 wave composition modulated-carrier signal outputted from the above-mentioned band-pass filter 30 is inputted into a demodulator circuit (DEM) 31, the 1st Carrier Detect circuit (CS1) 32, the 2nd Carrier Detect circuit (CS2) 33, and the 3rd Carrier Detect circuit (CS3) 34, respectively. A demodulator circuit 31 separates the above-mentioned 4 wave composition modulated-carrier signal for every subcarrier first, and restores to it respectively. And while carrying out error correction decode processing of the four receiving baseband signaling acquired by this recovery, respectively and reproducing receive-packet data, error detection and correction operations, such as a parity operation, are performed combining these four receive-packet data, and the right receive-packet data RD are reproduced. Moreover, a receive clock RCK is reproduced in the process which reproduces this receive-packet data RD. And a demodulator circuit 31 supplies the receive-packet data RD by which playback was carried out [above-mentioned], and a receive clock RCK to reception-control section 23b of an access controller 23. In reception-control section 23b of an access controller 23, the receive-packet data for transmitting to the body 10 of a terminal unit based on the above-mentioned receive-packet data RD and a receive clock RCK are generated. And this receive-packet data is transmitted to the body 10 of a terminal unit through the bus interface 21.

[0023] In order to judge the existence of use of the radio channel by the radar system, the 1st Carrier Detect circuit 32 detects the radar pulse signal transmitted from the radar base station RBS of a radar system RSM, and is comparing the level of a received carrier signal with the 1st Carrier Detect level CSL 1 set up beforehand. And from this 1st Carrier Detect level CSL 1, the 1st detecting signal CSS 1 is generated and an access controller 23 is supplied at the period when the large received carrier signal of level is detected.

[0024] Here, the Carrier Detect level CSL 1 of the above 1st is set up as follows, for example. Namely, it is supposed now that the transmitting output of the radar base station RBS is 500kW - 2000kW (+87dBm - +93dBm) temporarily. And interference wave arrival level for the radar base station RBS not to receive interference from a wireless LAN system sets to -130dBm. Supposing the transmitted power of the radio terminal unit TU of a wireless LAN system is furthermore 2.5mW (+4dBm) / carrier, the transmission-line loss for not interfering in the radar base station RBS will be set to +4dBm-(-130dBm) =134dB. For this reason, the receiving level of the radar pulse signal in the radio terminal unit TU of the wireless LAN system under the conditions in which this transmission-line loss exists is set to 87dBm-134dBm=-47dBm.

[0025] Here, if transmission-line loss of the transmission line which goes to the radar base station RBS from the radio terminal unit TU is equal to transmission-line loss of the transmission line which faces to the radio terminal unit TU from the radar base station RBS, when the receiving level of the radar pulse signal in the radio terminal unit TU is the above-mentioned -47dBm, the receiving level in the radar base station RBS of the radio signal transmitted from the radio terminal unit TU is also set to -47dBm. namely, when the receiving level of a radar pulse signal is the above-mentioned less than -47dBm in the radio terminal unit TU Even if the receiving level of the wireless sending signal of the radio terminal unit TU in the radar base station RBS is also set to less than -47dBm and the radio terminal unit TU transmits a wireless carrier signal with 2 or 5mW (+4dBm) transmitted power by this condition Since the received signal level in the radar base station RBS is set to -130dBm or less, the interference to a radar system RSM will be produced. Therefore, what is necessary will be to set the above-mentioned -47dBm as the 1st Carrier Detect level CSL 1, and just to detect a radar pulse signal according to this disregard level CSL1.

[0026] In addition, if it is in actual equipment, it is good to expect a several dB margin and to set the Carrier Detect level CSL 1 of the above 1st as -50dBm.
[0027] On the other hand, in a radar system RSM, even if it is the case where a radio signal comes through radio channels other than the radio channel currently used for transmission and reception of a radar wave depending on the bandwidth and the dynamic range of a front end (preamp) of the receiving system, interference by cross modulation may be received. The 2nd Carrier Detect circuit 33 is for judging whether interference by this cross modulation may be given to a radar system RSM, and is comparing the received signal level of the radar pulse signal transmitted from the radar base station RBS of a radar system RSM with the 2nd Carrier Detect level CSL 2 set up beforehand. And the 2nd detecting signal CSS 2 is generated and the access controller 23 is supplied at the period when the input signal with larger level than this 2nd Carrier Detect level CSL 2 is detected.
[0028] By the way, the Carrier Detect level CSL 2 of the above 2nd is set up as follows, for example. That is, the radio channel which a radar system RSM is using, and the received power P of the near frequency by the wireless LAN system received with a different radio-channel frequency in the radar base station RBS are called for as follows.
deltaP=p0 2 (delta/4piL) and G-Dtr-L theta-delta L -- here -- p0 For the sending-signal level of the wireless LAN system in a radar receiving band, and L, the distance from the radar base station RBS and G are [the beam width of a radar antenna and Dtr of the gain of a radar antenna and theta] the traffic densities (the rate of time amount / unit area) of the wireless LAN system RSM.
[0029]
[Equation 1]

$$P = \int_{L=L_{min}}^{L=L_{max}} dP$$

$$= p_0 \cdot (\lambda / 4\pi)^2 \cdot G \cdot Dtr \cdot \theta \cdot \ln(L_{max} / L_{min})$$

However, ln ( ) is a natural logarithm. A concrete numerical example is shown below.
G=3000(=34.8dB)
theta=(4 pi/G) 1/2 therefore -- Gtheta=(4piG)1/2 =1.94e2Dtr=5e-6 -- however Average traffic (rate of time amount) per 1e-4/m2 (that is, an average of 100m around consistency of one system), and 1 system was set to 5e-2 (about [of the maximum throughput of an equal distributed wireless LAN system] 1/10) for the installation consistency of a wireless LAN system.
[0030] If it does so, it is received power P. P (dBm) =p0 (dBm)-64.2+10 and log (ln (Lmax/Lmin)) It becomes. However, log ( ) is a common logarithm. It will be set to P= 54.2+10 and log (ln (Lmax/Lmin)) if the transmitting output of the wireless LAN system which is working by another radio channel is made into 10dBm, i.e., p0 =10dBm, (dBm). It is Lmax/Lmin when an out-of-band permission input level for the front end of a radar not to start cross modulation is set to -50dB here. It is set to 13.9. It is Lmin if the maximum range of the radar wave resulting from the radius of circle of the earth is set to 100km. It is set to 7.2km. The free space loss in a 1.2GHz band is 111.2dB, and the receiving level of a radar pulse signal [in / output level / (peak) / of a radar pulse signal / minimum / for the receiving-antenna gain of 35dB and a wireless LAN system / in the antenna gain of +87dBm and a radar / the distance of 0dB, then Lmin] is set to +10.8dBm. Of course, a wireless LAN system depends the above-mentioned out-of-band mold permission input level on the specification of the radar system which is going to share a radio channel.
[0031] If +10.8dBm for which it asked by the above numerical calculation is set up as 2nd Carrier Detect level CSL 2, it is possible to avoid that the radio signal from the wireless LAN system which is using the radio channel which approached to the radio channel which a radar system RSM is using causes interference by cross modulation by the front end of the radar base station RBS. If in charge of mounting to an actual radio communication equipment, it is needless to say in a suitable margin being set up based on the setting precision of the 2nd Carrier Detect level CSL 2 etc. If a 3dB margin is expected, specifically, the 2nd Carrier Detect level CSL 2 will be set to +7.8dBm.
[0032] On the other hand, in order to perform wireless transmission of the packet data based on a CSMA (carrier sense multiple access) method, the 3rd Carrier Detect circuit 34 is for detecting the

modulated-carrier signal transmitted from other radio terminal units TU in a wireless LAN system, and compares the level of a received carrier signal with the 3rd Carrier Detect level CSL 3 set up beforehand. And from this 3rd Carrier Detect level CSL 3, the 3rd detecting signal CSS 3 is generated and an access controller 23 is supplied at the period when the large received carrier signal of level is detected.
[0033] Here, the Carrier Detect level CSL 3 of the above 3rd is set up as follows. That is, while using a use frequency band as a 1.2GHz band temporarily now, free space loss (distance of 40m) is set to 60dBm, and received power (distance of 40m) is set to -62dBm. Moreover, thermal noise will be set to kxTxBxF=-104dBm if 2.5Mbaud(s) and the noise characteristic F are set to 6dB for bandwidth B. However, k is a Boltzmann's constant and T is temperature. The Carrier Detect level CSL 2 for detecting the radio signal which comes from other radio terminal units TU in a wireless LAN system from the above conditions is -84dBm (+20dBm of thermal noise), in order to detect existence of the radio signal from other radio communication equipments as much as possible, even if it does not malfunction in thermal noise and phasing occurs.
It is alike and sets up. By the way, radar use judging section 23c, and 23d of radar interference judging sections and wireless access-control section 23e are prepared in the access controller 23. Radar use judging section 23c detects the existence of operation of a radar system RSM based on the 1st detecting signal CSS 1 outputted from the Carrier Detect circuit 32 of the above 1st.
[0034] In addition, in this wireless LAN system, when the distance between radio communication equipments is very near (for example, when two radio communication equipments of a self-system exist at intervals of 1m), since free space loss is set to 34dB, the receiving level per radio-channel 1 carrier is set to -30dBm. In this case, since the set point of the 1st Carrier Detect level CSL 1 described previously is exceeded, a misjudgment law will be carried out to a radar pulse signal.
[0035] Then, in order to judge the existence of arrival of a radar pulse signal still more correctly, radar judging section 23c of an access controller 23 is constituted as shown in drawing 3 . That is, the 1st outputted detecting signal CSS 1 is inputted into the 1st selector 44, 2nd selector 46, and pulse duration judging circuit 42 through a buffer amplifier 41, respectively from the 1st Carrier Detect circuit 32. For the pulse duration judging circuit 42, generally, the signal length of a radar pulse signal is 1-10microsec. Also for the shortest, a packet data length is 50microsec to extent and a very short thing. Paying attention to becoming, or the detecting signal CSS 1 of the above 1st would not detect packet data, it judges whether it is what detected the radar pulse signal, and it consists of a counter and the judgment section. In a counter, pulse width T of the detecting signal CSS 1 of the above 1st is detected. Maximum packet data length Tmax pulse width T detected by the above-mentioned counter is beforehand remembered to be by Registers 43a and 43b in the judgment section And shortest packet data length Tmin It is compared respectively. And the comparison result is T<Tmin. Or T>Tmax The judgment signal PSS showing whether conditions are fulfilled or not is outputted.
[0036] The 1st selector 44 chooses and outputs one side of the 1st detecting signal CSS 1 and the pulse duration detecting signal outputted from the above-mentioned pulse duration judging circuit 42 according to the selection directions information memorized by the register 45, and this detecting signal by which the selection output was carried out is inputted into the periodic signal detection circuit 50. Generally the periodic signal detection circuit 50 pays its attention to a radar pulse signal to not having periodicity, since packet data are transmitted at random having clear periodicity. Or the above-mentioned detecting signal would not detect packet data, it judges whether it is what detected the radar pulse signal, and the judgment signal ISS showing the existence of the periodicity outputted from this periodic signal detection circuit 50 is inputted into the 2nd selector 46.
[0037] The 1st detecting signal CSS 1 outputted from the Carrier Detect circuit 32 of the above 1st in the 2nd selector 46 according to the selection directions information memorized by the register 47 One of the periodicity judging signals ISS showing the existence of the pulse duration judging signal PSS outputted from the above-mentioned pulse duration judging circuit 42 and the periodicity outputted from the above-mentioned periodic signal detection circuit 50 is chosen, and the number-of-stages protection network 48 is supplied.
[0038] In the number-of-stages protection network 48, counting of the count of an output of the detecting signal CSS 1 by which a selection output is carried out from the 2nd selector 46 of the

above, or the judgment signal ISS is carried out for every fixed time amount, and when it exceeds the count of backward alignment guard time these enumerated data are remembered to be by register 49a, the detection information showing the radar system RSM having started use of radio channels f1-f4 is generated. Moreover, when less than the count of forward alignment guard time the above-mentioned enumerated data are remembered to be by register 49b during radar use detection, the detection information showing the radar system RSM having suspended use of radio channels f1-f4 is generated. The detection flag register 51 sets / resets the detection flag showing the busy condition of the radio channels f1-f4 by the radar system RSM according to each above-mentioned detection information.

[0039] 23d of radar interference judging sections judges whether interference by cross modulation may be produced to a radar system RSM based on the 2nd detecting signal CSS 2 outputted from said 2nd Carrier Detect circuit 33. And the judgment result is supplied to wireless access-control section 23e.

[0040] Finally wireless access-control section 23e determines the existence of use of a radio channel based on the judgment result by said radar use judging section 23c, and the judgment result by the 23d of the above-mentioned radar interference judging sections. And when the Request to Send of a data packet comes from CPU11 of the body 10 of a terminal unit, a radio channel is accessed according to a CSMA method, and packet data are made to transmit and receive based on the 3rd detecting signal CSS 3 outputted from the 3rd Carrier Detect circuit 34, without making the cross modulation by interference of the same radio channel, and different radio channel start to a radar system RSM, after that it can be used has judged the radio channel.

[0041] Next, actuation of the equipment constituted as mentioned above is explained. In case a wireless LAN system starts operation, each radio communication equipment sends out the signal for declaring the purport whose self-equipment is an assumed-parents office to other radio communication equipments in a system after powering on, after the time amount which was beforehand changed for every equipment and was set up passes. Moreover, if a declaration signal comes from other equipments before it supervises arrival of the declaration signal from other radio communication equipments and self-equipment sends out a declaration signal in time amount until it sends out the above-mentioned declaration signal, each radio communication equipment will authorize the radio communication equipment which sent out this declaration signal as an assumed-parents station, and will follow directions of this assumed-parents station henceforth. That is, the radio communication equipment which sent out the declaration signal early most serves as an assumed-parents station.

[0042] Now, the radio communication equipment TU used as an assumed-parents office searchs two or more usable radio channels in order by the self system first, receives that radio signal, and judges whether the radar system RSM is using this radio channel for every radio channel by this.

[0043] That is, the wireless carrier signal transmitted by each radio channel is inputted into the 1st Carrier Detect circuit 32 through a low noise amplifier 29 and a band-pass filter 30, after being received by the antenna 27. In this 1st Carrier Detect circuit 32, it is detected whether the receiving level of the above-mentioned wireless carrier signal is more than the 1st Carrier Detect value CSL1 (-47dBm) set up beforehand, and that detecting signal is inputted into radar use judging section 23c of an access controller 23.

[0044] Radar use judging mode presupposes now that it was set as the mode judged using the 1st detecting signal CSS 1 temporarily. If it does so, since the 2nd selector 46 is set as the condition of carrying out the selection output of the detecting signal CSS 1 of the above 1st, in radar use judging section 23c, the detecting signal CSS 1 of the above 1st will be inputted into the number-of-stages protection network 48. In the number-of-stages protection network 48, it is judged whether it exceeded the count of backward alignment guard time by which the count of generating of the detecting signal CSS 1 of the above 1st was beforehand set up within a fixed period.

[0045] Suppose that now RSM, for example, a radar system, was performing the radar search in this condition using radio channels f1-f4. If it does so, whenever the radar pulse signal transmitted from the radar base station RBS is received, the 1st detecting signal CSS 1 will be outputted from the Carrier Detect circuit 32 of the above 1st. For this reason, the count of generating of the 1st detecting signal CSS 1 will exceed the count of backward alignment guard time within a fixed period, as a

result, from the above-mentioned number-of-stages protection network 48, the detection information which shows that it is [radar] under use is outputted, and the detection flag of a register 51 is set.
[0046] On the other hand, a radar system RSM presupposes that the radar search was performed using radio channels other than radio-channel f1 - f4. In this case, since a radar pulse signal is not received in radio channels f1-f4, the 1st detecting signal CSS 1 is not outputted from the 1st Carrier Detect circuit 32. For this reason, in the number-of-stages protection network 48 of radar use judging section 23c, the count of generating of the 1st detecting signal CSS 1 does not exceed the count of backward alignment guard time within a fixed period, therefore the detection flag of a register 51 holds a reset condition.
[0047] Moreover, when a radar system RSM changes a use channel from radio channels f1-f4 to other radio channels, the output of the 1st detecting signal CSS 1 from the 1st Carrier Detect circuit 32 stops. For this reason, in the number-of-stages protection network 48 of radar use judging section 23c, the count of generating of the 1st detecting signal CSS 1 will be less than the count of forward alignment guard time within a fixed period, the detection information which shows that the radar system RSM, as a result, is not using radio channels f1-f4 from the number-of-stages protection network 48 is outputted, and, thereby, the detection flag of a register 51 is reset.
[0048] Moreover, the radio communication equipment TU used as the above-mentioned assumed-parents station judges whether a radar system RSM causes interference by cross modulation, when wireless transmission is performed using the adjoining radio channel with the judgment of the existence of use of each radio channel by the above-mentioned radar system RSM.
[0049] That is, the wireless carrier signal transmitted by each radio channel is inputted into the 2nd Carrier Detect circuit 33 through a low noise amplifier 29 and a band-pass filter 30, after being received by the antenna 27. In this 2nd Carrier Detect circuit 33, it is detected whether the receiving level of the above-mentioned wireless carrier signal is more than the 2nd Carrier Detect value CSL2 (+10.8dBm) set up beforehand, and that detecting signal is inputted into 23d of radar interference judging sections of an access controller 23. In 23d of radar interference judging sections, it is judged whether there is any fear of producing interference by cross modulation to a radar system RSM according to the above-mentioned detecting signal CSS 2, and the judgment result is supplied to wireless access-control section 23e. The radio channel for which the radar system RSM is not using wireless access-control section 23e is detected, and even if other radio channels which moreover adjoin this radio channel perform wireless transmission, if judged with there being no fear of making interference by cross modulation cause in a radar system RSM, the above-mentioned radio channel is directed to each radio communication equipment in a system as a use channel.
[0050] Now, suppose that the operator inputted transmitting directions of packet data in the body 10 of a terminal unit in this condition. If it does so, CPU11 of the body 10 of a terminal unit will judge the condition of the detection flag 51 in radar use judging section 23c of an access controller 23 first. And if the condition of a detection flag 51 checks that it will have been in the reset condition, i.e., the condition of meaning the radar system RSM not using radio channels f1-f4, it writes transmitting packet data in the buffer memory 22 of the wireless LAN adapter 20 through the bus interface 21, and directs transmission of packet data to an access controller 23.
[0051] In response to these directions, an access controller 23 first judges whether other radio terminal units TU of a wireless LAN system are transmitting packet data using radio channels f1-f4 in 23d of wireless access-control sections based on the detecting signal CSS 2 of the 2nd Carrier Detect circuit 33. If judged with no radio terminal unit TU transmitting by this judgment, while sending out the transmitting packet data TD and a transmit clock TCK to a modulation circuit 24 from transmission-control section 23a next, the carrier switch signal CSW is sent out. For this reason, a modulation circuit 24 will be in the condition which can send out a carrier signal, and will start transmission of the modulated-carrier signal of four waves modulated with the above-mentioned transmitting packet data TD after that. In addition, in the 23d of the above-mentioned wireless access-control sections, when judged with radio channels f1-f4 already being used by other radio terminal units TU, transmitting authorization is not given from 23d of wireless access-control sections to transmission-control section 23a, and, as a result, transmission of transmitting packet data is not performed.
[0052] On the other hand, when the detection flag 51 of the above-mentioned radar use judging

section 23c is in the set condition, i.e., the condition of meaning a radar system RSM using radio channels f1-f4, other radio channels which the radar system RSM is not using by 23d of wireless access-control sections are searched. And if other radio channels are found, control for changing into this radio channel the radio channel which should be used (hand off) will be performed. The radio terminal unit TU of the arbitration in a wireless LAN system serves as an assumed-parents station temporarily, and this hand off control is performed when this assumed-parents station sends out a hand off command to other radio terminal units TU in a system.

[0053] On the other hand, a radar system RSM presupposes that the radio channel was changed to the radio channels f1-f4 which the wireless LAN system is using during the period when the radio terminal unit TU has transmitted packet data. If it does so, according to reception of the transmitted radar pulse signal, the 1st detecting signal CS 1 will be outputted from the 1st Carrier Detect circuit 32 from the radar base station RBS in this case. And if the cumulative value of the count of generating of this 1st detecting signal CSS 1 exceeds the count of backward alignment guard time within a fixed period, the detection flag register 51 of radar use judging section 23c will change to a set condition at that time. That is, a detection flag will be in the condition of meaning radio channels f1-f4 using it with a radar system RSM. Change of this detection flag 51 is detected by 23d of wireless access-control sections, and transmission-control section 23a stops transmission of packet data instancy according to this. Therefore, interference active jamming of the radar system RSM by the wireless LAN system is prevented. In addition, the radio terminal unit TU may perform hand off control described previously after this transmitting termination.

[0054] By the way, suppose that other radio terminal units TU with which the radio terminal unit TU is arranged by approaching comparatively by a certain cause during the period which is transmitting packet data, without this wireless carrier signal being undetectable started transmission of packet data. In this case, in the radio terminal unit TU under above-mentioned packet data transmission, since a wireless carrier signal -57dBm or more is received, the 1st detecting signal CSS 1 is outputted from the 1st Carrier Detect circuit 32. That is, in spite of having received not a radar pulse signal but the wireless carrier signal of transmitting packet data, the detecting signal showing the radar pulse signal having been detected is generated. For this reason, it is judged with that by which use of radio channels f1-f4 was started with the radar system RSM, and transmission of the packet data based on transmission-control section 23a is stopped by radar use judging section 23c according to this. That is, transmission will be stopped in spite of not stopping transmission of packet data.

[0055] In order to avoid such a situation, the selection directions information on the register 47 of radar use judging section 23c is rewritten with the body 10 of a terminal unit, and the pulse duration judging signal PSS outputted from the pulse duration judging circuit 42 in the 2nd selector 46 by this is chosen. When it does so, the judgment signal PSS outputted from the pulse duration judging circuit 42 is supplied to the number-of-stages protection network 48, and, thereby, the condition of a detection flag 51 is made to change based on the count of generating of the above-mentioned judgment signal PSS in the number-of-stages protection network 48. Here, the above-mentioned pulse duration judging circuit 42 has the pulse width of the 1st detecting signal CSS 1 shorter than the shortest packet data length (50microsec), or only when longer than the longest packet data length, the judgment signal PSS is outputted. For this reason, when that pulse width is equivalent to a packet data length, the judgment signal PSS is not outputted, but even if the 1st detecting signal CSS 1 is generated from the 1st Carrier Detect circuit 32, when pulse signal length is shorter than the shortest packet data length, the judgment signal PSS will be outputted like a radar pulse signal (1-10micro sec of pulse duration). For this reason, according to the count of generating of the above-mentioned pulse duration judging signal PSS, the detection flag 51 with which a radar system RSM expresses whether it is under [use] ****** for radio channels f1-f4 will be controlled by the number-of-stages protection network 48. Therefore, packet data with large receiving level are incorrect-recognized to be a radar pulse signal, and the situation of stopping transmission of packet data is avoided.

[0056] Although surely the interference to a radar system RSM is prevented from a wireless LAN system as it is such a high disregard level on the other hand although one was considered as the Carrier Detect level CSL of -57dBm set as the 1st Carrier Detect circuit 32 in the above explanation, the interference to a wireless LAN system from a radar system RSM is not prevented. That is,

depending on the receiving level, interference may sometimes be given [enough] to receive-packet data just because the receiving level of a radar pulse signal is less than -57 dms. What is necessary is just to set the 1st Carrier Detect level CSL 1 as the smaller value of for example, +10dBm (-94dBm) extent of thermal noise, in order to reduce this fault. However, it is necessary to detect not only a radar pulse signal but the radio signal which comes from other adjoining wireless LAN systems, when it does in this way, to distinguish a radar pulse signal from the radio signal from other wireless LAN systems, and to detect it.

[0057] It is also effective to use the pulse duration judging circuit 42 described previously as the detection means. However, even if the signal length and the shortest packet data length of a radar pulse signal are almost the same or there is a difference again, in not being a big difference, in the above-mentioned pulse duration judging circuit 42, it becomes difficult to perform an exact judgment.

[0058] So, in order to cope with it in such a case, it is effective to use the periodic signal detection circuit 50 established in radar use judging section 23c. That is, the selection directions information on the register 47 of radar use judging section 23c is rewritten with the body 10 of a terminal unit, and it sets up so that the judgment signal ISS outputted from the periodic signal detection circuit 50 in the 2nd selector 46 by this may be chosen. When it does so, the judgment signal ISS outputted from the periodic signal detection circuit 50 will be supplied to the number-of-stages protection network 48, and the number-of-stages protection network 48 makes the condition of a detection flag 51 change based on the judgment signal ISS of this periodic signal. Here, as stated previously, since it is transmitted at random, generally packet data have clear periodicity for the radar pulse signal to not having periodicity. And paying attention to this point, the above-mentioned periodic signal detection circuit 50 has judged whether it is what detected the radar pulse signal, or the 1st detecting signal CSS 1 or the judgment signal PSS of the pulse duration judging circuit 42 would not detect packet data. For this reason, if these detecting signals CSS 1 or the judgment signal PSS is not a signal which has periodicity whether the 1st detecting signal CSS 1 is generated from the 1st Carrier Detect circuit 32 or the judgment signal PSS is generated from the pulse duration judging circuit 42 and, the judgment signal ISS will not be generated from the above-mentioned periodic signal detection circuit 50. Therefore, according to the count of generating of the judgment signal with which it expresses more clearly that it is the judgment signal ISS, i.e., a radar pulse signal, outputted from the above-mentioned periodic signal detection circuit 50, the detection flag 51 with which a radar system RSM expresses whether it is under [use] ****** for radio channels f1-f4 will be controlled by the number-of-stages protection network 48. For this reason, the fault to which a radar pulse signal, receiving level, and signal length make the packet data of other almost equal wireless LAN systems a radar pulse signal, and do a misjudgment law is reduced, and it enables this to transmit packet data to stability.

[0059] Independently [the 3rd Carrier Detect circuit 34 required as stated above, in order to perform wireless packet transmission to the radio terminal unit TU in this example according to a CSMA method] The 1st Carrier Detect circuit 32 and radar use judging section 23c are prepared. It has judged whether the 1st Carrier Detect circuit 32 detects a wireless carrier signal with larger receiving level than the Carrier Detect level CSL 1, and the radar system RSM is using the radio channel in radar use judging section 23c based on the detecting signal CSS 1. And when a radar system RSM judges that it is [a radio channel] under use, it is made not to transmit the packet data based on this radio channel.

[0060] Moreover, it has the 2nd Carrier Detect circuit 33 and 23d of radar interference judging sections, even if it is the case where a radio signal is transmitted by these circuits using radio channels other than the radio channel which a self system is using, it judges whether cross modulation may be given to a radar system RSM, and when cross modulation may be given, he is trying to forbid use of all radio channels in the radio communication equipment TU of this example. For this reason, the fault which does interference active jamming by cross modulation to a radar system RSM is prevented certainly.

[0061] Therefore, according to this example, in spite of performing the radio transmission of packet data in the wireless area of the existing laser system using the same radio channel, a wireless LAN system can be worked, without having bad influences, such as interference active jamming, to laser

system RSM. That is, even if it is the frequency band with which the frequency which can be assigned to a new radio communications system does not remain like a semi- microwave band, a wireless LAN system can be employed.

[0062] Moreover, the pulse duration judging circuit 42 is formed and it enables it to judge the existence of use of the radio channel by the radar system RSM in this example based on the judgment signal PSS of this pulse duration judging circuit 42 as a means for judging the existence of use of the radio channel by the radar system RSM in addition to the 1st Carrier Detect circuit 32 which judges receiving level. Therefore, the fault which incorrect-recognizes receive-packet data with large receiving level to be a radar pulse signal is reduced, and the situation of stopping transmission of packet data superfluously by this is avoided.

[0063] Furthermore by this example, as a means for judging the existence of use of the radio channel by the radar system RSM Newly form the periodic signal detection circuit 50, input into the above-mentioned periodic signal detection circuit 50 the detecting signal CSS 1 of the 1st Carrier Detect circuit 32 which judges receiving level, or the judgment signal PSS of the pulse duration judging circuit 42, and the existence of the periodicity is judged. It enables it to judge the existence of use of the radio channel by the radar system RSM based on this judgment signal ISS. When it follows, for example, disregard level CSL1 of the 1st Carrier Detect circuit 32 is set up low, and even when it is difficult between the signal length of a radar pulse signal, and the shortest packet data length to judge a laser pulse signal by receiving level or pulse duration like [in case there is no clear difference], the existence of use of the radio channel by the radar system RSM can be judged correctly.

[0064] In addition, this invention is not limited to the above-mentioned example. For example, the mode judged based on the detecting signal CSS 1 of a. receiving level in the above-mentioned example as the mode for judging the existence of use of the radio channel by the radar system RSM.

b. The mode judged based on the detecting signal CSS 1 of receiving level, and the pulse duration judging signal PSS.

c. The mode judged based on the judgment signal ISS showing the existence of the detecting signal CSS 1 of receiving level or the pulse duration judging signal PSS, and its periodicity. The ******** case was described. However, the mode judged based on d. pulse duration judging signal PSS as the other mode.

e. The mode judged based on the judgment signal ISS showing the existence of periodicity.

You may use it.

[0065] Moreover, you may apply in order to judge whether an interference according the judgment approach which uses each above mode alternatively to cross modulation may be given to a radar system. Moreover, you may constitute so that LED and LCD may be used for a radio communication equipment and the judgment result may be displayed on it.

[0066] Furthermore, although said example explained taking the case of the case where share the radio channel of a radar system RSM and a wireless LAN system is built, otherwise a cellular automobile and a cellular-phone system, selective-calling communication system, an MCA system, yard mobile radio communication system, etc. and a radio channel are shared, and you may make it build a wireless LAN system.

[0067] In addition, also with the configuration of the class [of 2nd wireless system], configuration, class [of radio communication equipment] and configuration, 1st, and 2nd judgment means, the configuration and control procedure of a radio-channel use control means, and the transmitting procedure of transmitting packet data, in the range which does not deviate from the summary of this invention, it deforms variously and can carry out.

[0068]

[Effect of the Invention] As explained in full detail above, the radio communication equipment of this invention In order to know the condition of a radio channel, it has the 1st judgment means and the 2nd judgment means. With the 1st judgment means The radio signal transmitted through the above-mentioned radio channel is received, and the busy condition of the above-mentioned radio channel by the 1st existing wireless system is judged based on the receiving result. Further with the 2nd judgment means The radio signal transmitted through the radio channel was received, and even if it is the case where a radio signal is transmitted using radio channels other than the radio channel concerned based on the receiving result, it has judged whether cross modulation may be given to the

wireless system of the above 1st. And it is made to perform the processing for avoiding use of the radio channel concerned, when judged with it being in the condition that it can be regarded as under use of the above-mentioned radio channel with the judgment means of the above 1st, by the radio-channel use control means, and avoiding use of all radio channels, when judged with cross modulation being given to the wireless system of the above 1st with the judgment means of the above 2nd.

[0069] Therefore, according to this invention, radio can be performed without doing bad influences, such as interference active jamming and cross modulation, in the wireless area of the existing wireless system, and the radio communication equipment which can realize a new radio communications system by this using a desired frequency band can be offered.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] This invention relates to the radio communication equipment used in order to share the radio channel in the wireless area of the wireless system of especially existing, such as a radar system, and to perform radio with respect to the radio communication equipment used with radio communications systems, such as a wireless LAN (local area netwoak) system.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In recent years, various radio communications systems are advocated with increase of communication link needs, or progress of a radio technique, and a wireless LAN system is in one of them. This wireless LAN system carries out the radio transmission of the data in service areas limited comparatively, such as an office building and a place of business, between [, such as a host computer, a personal computer, a printer, and electronic file equipment] terminal units.
[0003] By the way, as a data transmission rate of this kind of system, he is IEEE802.3, for example. The rate of 10 or more Mbpses is wished that it is represented by CSMA/CD, and in order to realize this transmission speed, the bandwidth of dozens of MHz or more is needed. Moreover, since the silicon device is available because of that free space loss is small for power consumption reduction of radio equipment as a frequency band in the case of realizing this kind of wireless LAN system, and cheap-izing of radio equipment, a semi- microwave band 3GHz or less is suitable. However, the actual condition is that there is no room to be ending and newly assign [most frequencies assign other existing systems, and] a band dozens of MHz or more with a semi- microwave band for a wireless LAN system.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained in full detail above, the radio communication equipment of this invention In order to know the condition of a radio channel, it has the 1st judgment means and the 2nd judgment means. With the 1st judgment means The radio signal transmitted through the above-mentioned radio channel is received, and the busy condition of the above-mentioned radio channel by the 1st existing wireless system is judged based on the receiving result. Further with the 2nd judgment means The radio signal transmitted through the radio channel was received, and even if it is the case where a radio signal is transmitted using radio channels other than the radio channel concerned based on the receiving result, it has judged whether cross modulation may be given to the wireless system of the above 1st. And it is made to perform the processing for avoiding use of the radio channel concerned, when judged with it being in the condition that it can be regarded as under use of the above-mentioned radio channel with the judgment means of the above 1st, by the radio-channel use control means, and avoiding use of all radio channels, when judged with cross modulation being given to the wireless system of the above 1st with the judgment means of the above 2nd.
[0069] Therefore, according to this invention, radio can be performed without doing bad influences, such as interference active jamming and cross modulation, in the wireless area of the existing wireless system, and the radio communication equipment which can realize a new radio communications system by this using a desired frequency band can be offered.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Even if it is going to realize a new radio communications system like a wireless LAN system as mentioned above, the present condition is that there is no suitable available frequency band, and it is in a difficult situation to realize a new radio communications system for this reason.
[0005] It is offering the radio communication equipment which this invention's was made paying attention to the above-mentioned situation, the place made into the purpose enables it to perform radio, without doing bad influences, such as interference active jamming and cross modulation, to the existing wireless system, and can realize a new radio communications system by this using a desired frequency band.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose the radio communication equipment of this invention In order to know the condition of a radio channel, it has the 1st judgment means and the 2nd judgment means. With the 1st judgment means The radio signal transmitted through the above-mentioned radio channel is received, and the busy condition of the above-mentioned radio channel by the 1st existing wireless system is judged based on the receiving result. Further with the 2nd judgment means The radio signal transmitted through the radio channel was received, and even if it is the case where a radio signal is transmitted using radio channels other than the radio channel concerned based on the receiving result, it has judged whether cross modulation may be given to the wireless system of the above 1st. And it is made to perform the processing for avoiding use of the radio channel concerned, when judged with it being in the condition that it can be regarded as under use of the above-mentioned radio channel with the judgment means of the above 1st, by the radio-channel use control means, and avoiding use of all radio channels, when judged with cross modulation being given to the wireless system of the above 1st with the judgment means of the above 2nd.
[0007] Moreover, while this invention compares with the 1st predetermined threshold level the signal level of the radio signal transmitted through the selected radio channel in the 1st judgment means with a comparison means A detection means detects either [at least] the signal length of the radio signal by which transmission was carried out [above-mentioned], or the periodicity of a signal. It is characterized also by using alternatively the signal length by the comparison result of the signal level by the above-mentioned comparison means, and the above-mentioned detection means, or the detection result of the periodicity of a signal, and judging the existence of use of the radio channel concerned by the 1st wireless system.
[0008] The 1st threshold level of the above is good in that case to set up so that the radio signal which self-equipment transmitted may be received with predetermined allowances to the minimum receiving sensitivity level assumed by the wireless system of the above 1st.
[0009] Furthermore, while this invention compares the signal level of the radio signal transmitted through the selected radio channel in the 2nd judgment means with the 2nd different predetermined threshold level and different predetermined comparison means from the 1st threshold level of the above A detection means detects either [at least] the signal length of the radio signal by which transmission was carried out [above-mentioned], or the periodicity of a signal. It is characterized also by judging whether the signal length by the comparison result of the signal level by the above-mentioned comparison means and the above-mentioned detection means or the detection result of the periodicity of a signal is used alternatively, and there is any possibility of giving cross modulation to the wireless system of the above 1st.
[0010] The 2nd threshold level of the above is good in that case to set up so that the radio signal which self-equipment transmitted may be received by the wireless system of the above 1st with predetermined allowances to the minimum received signal level assumed to cause cross modulation.

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OPERATION

[Function] As a result of judging the busy condition of a radio channel with the 1st judgment means, when it can be considered as a result according to this invention that the 1st existing wireless system is using this radio channel, the radio which used this radio channel is avoided. For this reason, it is the existing wireless system and common wireless area, and in spite of using a common radio channel, it becomes possible to employ the 2nd new wireless system, without having bad influences, such as interference active jamming, on the existing wireless system.
[0012] Moreover, when are judged with the 1st wireless system not using the radio channel and self-equipment is located near the radio communication equipment of the 1st wireless system, interference by cross modulation may occur in the radio communication equipment of the 1st wireless system by wireless transmission of self-equipment. However, in this invention, if it is judged with cross modulation being given to the 1st wireless system even if it is the case where a radio signal is transmitted using radio channels other than the radio channel concerned, as a result of judging the condition of a radio channel with the 2nd judgment means, use of all radio channels will be avoided. For this reason, the fault which causes the interference active jamming by cross modulation to the 1st existing wireless system is prevented certainly.
[0013] Therefore, according to this invention, it becomes possible to realize easily new radio communications systems, such as a wireless LAN system, using frequency bands, such as a semi-microwave band which cannot newly assign a frequency.
[0014] Moreover, when it is judged whether it is in the condition that it can be regarded as under use of a radio channel by the 1st wireless system, in this invention, And in case cross modulation may be given to the 1st wireless system or the country is judged, while judging the received signal level of a radio signal Either [at least] signal length or the periodicity are detected, and it is judging, using alternatively the judgment result of such receiving level and signal length, or the detection result of periodicity. For this reason, when the equipment with which the 1st wireless system sends out the radio signal which has high peaking capacity level like for example, a broader-based radar system, and sends out radio signals other than the 1st wireless system does not exist in point-blank range, it becomes possible to judge the busy condition of the radio channel by the 1st wireless system only with the received signal level of a radio signal. Moreover, even when the equipment which sends out radio signals other than the 1st wireless system to point-blank range exists, by detecting the signal length or periodicity of a radio signal, the effect of the radio signal of systems other than the 1st wireless system is reduced, and it becomes possible more to judge stability and the busy condition of a radio channel according to the 1st wireless system certainly, without this causing an incorrect judging.

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EXAMPLE

[Example] This invention is explained based on an example below.
[0016] Drawing 1 is the schematic diagram showing the arrangement relation between the wireless LAN system concerning one example of this invention, and the existing radar system.
[0017] A radar system RSM has one radar base station RBS, and the radar wireless area ER according to the transmitted power of the radar base station RBS is formed in the predetermined field centering on this radar base station RBS. In this radar wireless area ER, two or more wireless LAN systems (drawing three systems) LSM1-LSM3 are installed. These wireless LAN systems LSM1-LSM3 are wireless LAN systems called the so-called equal distributed type, and have held two or more radio terminal units TU11-TU14, TU21-TU23, and TU31-TU34, respectively. A distributed type equal wireless LAN system is a system which it does not have a centralized-control station in a system, but each radio terminal unit performs control for a communication link autonomously respectively, and performs direct wireless data transmission between radio terminal units. Connection between each wireless LAN systems LSM [LSM1-] 3 is made by connecting the radio terminal units TU14, TU23, and TU31 of the arbitration in a system through a wire circuit WL.
[0018] By the way, each radio terminal units TU11-TU14, TU21-TU23, and TU31-TU34 (TU is called henceforth) are what used a host computer, a personal computer, a printer, or electronic file equipment as the body of a terminal unit, for example, they are constituted as follows. Drawing 2 is the circuit block diagram showing the important section configuration. That is, the radio terminal unit TU consists of a body 10 of a terminal unit, and a wireless LAN adapter 20 attached to this body 10 of a terminal unit. The terminal body 10 has packet data origination, such as CPU11 and memory 12, and a configuration required for storage.
[0019] The wireless LAN adapter 20 is equipped with the bus interface (I/F) 21 for performing packet data transfer between the above-mentioned bodies 10 of a terminal unit, and after the transmitting packet data transmitted from the body 10 of a terminal unit through this bus interface 21 are stored in buffer memory 22 temporarily, they are inputted into transmission-control section 23a of an access controller 23. Transmission-control section 23a of an access controller 23 will supply this transmitting packet data TD and a transmit clock TCK to a modulation circuit (MOD) 24 with the carrier switch signal CSW, if the above-mentioned transmitting packet data TD are inputted.
[0020] A modulation circuit 24 performs error correcting code-ized processing to the above-mentioned transmitting packet data SD first. And this error-correcting-code-ized transmitting packet data TD is trichotomized, and it inputs into three different modulators. These modulators modulate the subcarriers f1-f3 which are three from which a frequency differs according to the transmitting packet data by which trichotomy was carried out [above-mentioned], respectively. Moreover, a modulation circuit 24 generates parity information based on each transmitting packet data by which trichotomy was carried out [above-mentioned], and inputs this parity information into other modulators. This modulator modulates the 4th subcarrier f4 according to the above-mentioned parity information. After the modulated-carrier signal outputted from these four modulators is compounded, it is inputted into the transmitted power amplifier 26. The transmitted power amplifier 25 amplifies the above-mentioned 4 wave composition modulated-carrier signal to the transmission level to which it was specified by the system. At this time, a transmission level is set for example, as 2.5mW / carrier. For this reason, the modulated-carrier signal which compounded four waves as mentioned above is set to a total of 10mW, and is outputted. 4 wave composition modulated-carrier

signal outputted from this transmitted power amplifier 25 is supplied to an antenna 27 through a circulator 26, and wireless transmission is carried out towards other radio terminal units TU in a system from this antenna 27. In addition, the above-mentioned carrier switch signal CSW is a signal for preventing the output of the modulated-carrier signal from a modulation circuit 24 at the period which does not need to transmit a subcarrier.

[0021] On the other hand, after 4 wave composition modulated-carrier signal received with the antenna 27 passes through a circulator 26 and the high frequency switch (SW) 28, the sequential input of it is carried out at a low noise amplifier 29 and a band-pass filter 30. In a low noise amplifier 29, the radio signal by which reception was carried out [above-mentioned] is amplified by signal level required for recovery processing. Only the radio frequency component of a predetermined band is extracted in a band-pass filter 30. In addition, the high frequency switch 28 was formed in order to prevent that the transmitting radio signal reflected with the antenna 27 at the time of transmission turns to a receiving system, and only a receiving period flows through it according to the control signal outputted from an access controller 23.

[0022] 4 wave composition modulated-carrier signal outputted from the above-mentioned band-pass filter 30 is inputted into a demodulator circuit (DEM) 31, the 1st Carrier Detect circuit (CS1) 32, the 2nd Carrier Detect circuit (CS2) 33, and the 3rd Carrier Detect circuit (CS3) 34, respectively. A demodulator circuit 31 separates the above-mentioned 4 wave composition modulated-carrier signal for every subcarrier first, and restores to it respectively. And while carrying out error correction decode processing of the four receiving baseband signaling acquired by this recovery, respectively and reproducing receive-packet data, error detection and correction operations, such as a parity operation, are performed combining these four receive-packet data, and the right receive-packet data RD are reproduced. Moreover, a receive clock RCK is reproduced in the process which reproduces this receive-packet data RD. And a demodulator circuit 31 supplies the receive-packet data RD by which playback was carried out [above-mentioned], and a receive clock RCK to reception-control section 23b of an access controller 23. In reception-control section 23b of an access controller 23, the receive-packet data for transmitting to the body 10 of a terminal unit based on the above-mentioned receive-packet data RD and a receive clock RCK are generated. And this receive-packet data is transmitted to the body 10 of a terminal unit through the bus interface 21.

[0023] In order to judge the existence of use of the radio channel by the radar system, the 1st Carrier Detect circuit 32 detects the radar pulse signal transmitted from the radar base station RBS of a radar system RSM, and is comparing the level of a received carrier signal with the 1st Carrier Detect level CSL 1 set up beforehand. And from this 1st Carrier Detect level CSL 1, the 1st detecting signal CSS 1 is generated and an access controller 23 is supplied at the period when the large received carrier signal of level is detected.

[0024] Here, the Carrier Detect level CSL 1 of the above 1st is set up as follows, for example. Namely, it is supposed now that the transmitting output of the radar base station RBS is 500kW - 2000kW (+87dBm - +93dBm) temporarily. And interference wave arrival level for the radar base station RBS not to receive interference from a wireless LAN system sets to -130dBm. Supposing the transmitted power of the radio terminal unit TU of a wireless LAN system is furthermore 2.5mW (+4dBm) / carrier, the transmission-line loss for not interfering in the radar base station RBS will be set to +4dBm-(-130dBm) =134dB. For this reason, the receiving level of the radar pulse signal in the radio terminal unit TU of the wireless LAN system under the conditions in which this transmission-line loss exists is set to 87dBm-134dBm=-47dBm.

[0025] Here, if transmission-line loss of the transmission line which goes to the radar base station RBS from the radio terminal unit TU is equal to transmission-line loss of the transmission line which faces to the radio terminal unit TU from the radar base station RBS, when the receiving level of the radar pulse signal in the radio terminal unit TU is the above-mentioned -47dBm, the receiving level in the radar base station RBS of the radio signal transmitted from the radio terminal unit TU is also set to -47dBm. namely, when the receiving level of a radar pulse signal is the above-mentioned less than -47dBm in the radio terminal unit TU Even if the receiving level of the wireless sending signal of the radio terminal unit TU in the radar base station RBS is also set to less than -47dBm and the radio terminal unit TU transmits a wireless carrier signal with 2 or 5mW (+4dBm) transmitted power by this condition Since the received signal level in the radar base station RBS is set to -130dBm or

less, the interference to a radar system RSM will be produced. Therefore, what is necessary will be to set the above-mentioned -47dBm as the 1st Carrier Detect level CSL 1, and just to detect a radar pulse signal according to this disregard level CSL1.

[0026] In addition, if it is in actual equipment, it is good to expect a several dB margin and to set the Carrier Detect level CSL 1 of the above 1st as -50dBm.

[0027] On the other hand, in a radar system RSM, even if it is the case where a radio signal comes through radio channels other than the radio channel currently used for transmission and reception of a radar wave depending on the bandwidth and the dynamic range of a front end (preamp) of the receiving system, interference by cross modulation may be received. The 2nd Carrier Detect circuit 33 is for judging whether interference by this cross modulation may be given to a radar system RSM, and is comparing the received signal level of the radar pulse signal transmitted from the radar base station RBS of a radar system RSM with the 2nd Carrier Detect level CSL 2 set up beforehand. And the 2nd detecting signal CSS 2 is generated and the access controller 23 is supplied at the period when the input signal with larger level than this 2nd Carrier Detect level CSL 2 is detected.

[0028] By the way, the Carrier Detect level CSL 2 of the above 2nd is set up as follows, for example. That is, the radio channel which a radar system RSM is using, and the received power P of the near frequency by the wireless LAN system received with a different radio-channel frequency in the radar base station RBS are called for as follows.

deltaP=p0 2 (delta/4piL) and G-Dtr-L theta-delta L -- here -- p0 For the sending-signal level of the wireless LAN system in a radar receiving band, and L, the distance from the radar base station RBS and G are [the beam width of a radar antenna and Dtr of the gain of a radar antenna and theta] the traffic densities (the rate of time amount / unit area) of the wireless LAN system RSM.

[0029]

[Equation 1]

$$P = \int_{L=L_{min}}^{L=L_{max}} dP$$

$$= p_0 \cdot (\lambda / 4\pi)^2 \cdot G \cdot Dtr \cdot \theta \cdot \ln(L_{max}/L_{min})$$

However, ln ( ) is a natural logarithm. A concrete numerical example is shown below.

G=3000(=34.8dB)

theta=(4 pi/G) 1/2 therefore -- Gtheta=(4piG)1/2 =1.94e2Dtr=5e-6 -- however Average traffic (rate of time amount) per 1e-4/m2 (that is, an average of 100m around consistency of one system), and 1 system was set to 5e-2 (about [of the maximum throughput of an equal distributed wireless LAN system] 1/10) for the installation consistency of a wireless LAN system.

[0030] If it does so, it is received power P. P (dBm) =p0 (dBm)-64.2+10 and log (ln (Lmax/Lmin)) It becomes. However, log ( ) is a common logarithm. It will be set to P= 54.2+10 and log (ln (Lmax/Lmin)) if the transmitting output of the wireless LAN system which is working by another radio channel is made into 10dBm, i.e., p0 =10dBm, (dBm). It is Lmax/Lmin when an out-of-band permission input level for the front end of a radar not to start cross modulation is set to -50dB here. It is set to 13.9. It is Lmin if the maximum range of the radar wave resulting from the radius of circle of the earth is set to 100km. It is set to 7.2km. The free space loss in a 1.2GHz band is 111.2dB, and the receiving level of a radar pulse signal [in / output level / (peak) / of a radar pulse signal / minimum / for the receiving-antenna gain of 35dB and a wireless LAN system / in the antenna gain of +87dBm and a radar / the distance of 0dB, then Lmin] is set to +10.8dBm. Of course, a wireless LAN system depends the above-mentioned out-of-band mold permission input level on the specification of the radar system which is going to share a radio channel.

[0031] If +10.8dBm for which it asked by the above numerical calculation is set up as 2nd Carrier Detect level CSL 2, it is possible to avoid that the radio signal from the wireless LAN system which is using the radio channel which approached to the radio channel which a radar system RSM is using causes interference by cross modulation by the front end of the radar base station RBS. If in charge of mounting to an actual radio communication equipment, it is needless to say in a suitable margin being set up based on the setting precision of the 2nd Carrier Detect level CSL 2 etc. If a 3dB margin

is expected, specifically, the 2nd Carrier Detect level CSL 2 will be set to +7.8dBm.

[0032] On the other hand, in order to perform wireless transmission of the packet data based on a CSMA (carrier sense multiple access) method, the 3rd Carrier Detect circuit 34 is for detecting the modulated-carrier signal transmitted from other radio terminal units TU in a wireless LAN system, and compares the level of a received carrier signal with the 3rd Carrier Detect level CSL 3 set up beforehand. And from this 3rd Carrier Detect level CSL 3, the 3rd detecting signal CSS 3 is generated and an access controller 23 is supplied at the period when the large received carrier signal of level is detected.

[0033] Here, the Carrier Detect level CSL 3 of the above 3rd is set up as follows. That is, while using a use frequency band as a 1.2GHz band temporarily now, free space loss (distance of 40m) is set to 60dBm, and received power (distance of 40m) is set to -62dBm. Moreover, thermal noise will be set to kxTxBxF=-104dBm if 2.5Mbaud(s) and the noise characteristic F are set to 6dB for bandwidth B. However, k is a Boltzmann's constant and T is temperature. The Carrier Detect level CSL 2 for detecting the radio signal which comes from other radio terminal units TU in a wireless LAN system from the above conditions is -84dBm (+20dBm of thermal noise), in order to detect existence of the radio signal from other radio communication equipments as much as possible, even if it does not malfunction in thermal noise and phasing occurs.

It is alike and sets up. By the way, radar use judging section 23c, and 23d of radar interference judging sections and wireless access-control section 23e are prepared in the access controller 23. Radar use judging section 23c detects the existence of operation of a radar system RSM based on the 1st detecting signal CSS 1 outputted from the Carrier Detect circuit 32 of the above 1st.

[0034] In addition, in this wireless LAN system, when the distance between radio communication equipments is very near (for example, when two radio communication equipments of a self-system exist at intervals of 1m), since free space loss is set to 34dB, the receiving level per radio-channel 1 carrier is set to -30dBm. In this case, since the set point of the 1st Carrier Detect level CSL 1 described previously is exceeded, a misjudgment law will be carried out to a radar pulse signal.

[0035] Then, in order to judge the existence of arrival of a radar pulse signal still more correctly, radar judging section 23c of an access controller 23 is constituted as shown in drawing 3 . That is, the 1st outputted detecting signal CSS 1 is inputted into the 1st selector 44, 2nd selector 46, and pulse duration judging circuit 42 through a buffer amplifier 41, respectively from the 1st Carrier Detect circuit 32. For the pulse duration judging circuit 42, generally, the signal length of a radar pulse signal is 1-10microsec. Also for the shortest, a packet data length is 50microsec to extent and a very short thing. Paying attention to becoming, or the detecting signal CSS 1 of the above 1st would not detect packet data, it judges whether it is what detected the radar pulse signal, and it consists of a counter and the judgment section. In a counter, pulse width T of the detecting signal CSS 1 of the above 1st is detected. Maximum packet data length Tmax pulse width T detected by the above-mentioned counter is beforehand remembered to be by Registers 43a and 43b in the judgment section And shortest packet data length Tmin It is compared respectively. And the comparison result is $T<T_{min}$. Or $T>T_{max}$ The judgment signal PSS showing whether conditions are fulfilled or not is outputted.

[0036] The 1st selector 44 chooses and outputs one side of the 1st detecting signal CSS 1 and the pulse duration detecting signal outputted from the above-mentioned pulse duration judging circuit 42 according to the selection directions information memorized by the register 45, and this detecting signal by which the selection output was carried out is inputted into the periodic signal detection circuit 50. Generally the periodic signal detection circuit 50 pays its attention to a radar pulse signal to not having periodicity, since packet data are transmitted at random having clear periodicity. Or the above-mentioned detecting signal would not detect packet data, it judges whether it is what detected the radar pulse signal, and the judgment signal ISS showing the existence of the periodicity outputted from this periodic signal detection circuit 50 is inputted into the 2nd selector 46.

[0037] The 1st detecting signal CSS 1 outputted from the Carrier Detect circuit 32 of the above 1st in the 2nd selector 46 according to the selection directions information memorized by the register 47 One of the periodicity judging signals ISS showing the existence of the pulse duration judging signal PSS outputted from the above-mentioned pulse duration judging circuit 42 and the periodicity outputted from the above-mentioned periodic signal detection circuit 50 is chosen, and the number-

of-stages protection network 48 is supplied.

[0038] In the number-of-stages protection network 48, counting of the count of an output of the detecting signal CSS 1 by which a selection output is carried out from the 2nd selector 46 of the above, or the judgment signal ISS is carried out for every fixed time amount, and when it exceeds the count of backward alignment guard time these enumerated data are remembered to be by register 49a, the detection information showing the radar system RSM having started use of radio channels f1-f4 is generated. Moreover, when less than the count of forward alignment guard time the above-mentioned enumerated data are remembered to be by register 49b during radar use detection, the detection information showing the radar system RSM having suspended use of radio channels f1-f4 is generated. The detection flag register 51 sets / resets the detection flag showing the busy condition of the radio channels f1-f4 by the radar system RSM according to each above-mentioned detection information.

[0039] 23d of radar interference judging sections judges whether interference by cross modulation may be produced to a radar system RSM based on the 2nd detecting signal CSS 2 outputted from said 2nd Carrier Detect circuit 33. And the judgment result is supplied to wireless access-control section 23e.

[0040] Finally wireless access-control section 23e determines the existence of use of a radio channel based on the judgment result by said radar use judging section 23c, and the judgment result by the 23d of the above-mentioned radar interference judging sections. And when the Request to Send of a data packet comes from CPU11 of the body 10 of a terminal unit, a radio channel is accessed according to a CSMA method, and packet data are made to transmit and receive based on the 3rd detecting signal CSS 3 outputted from the 3rd Carrier Detect circuit 34, without making the cross modulation by interference of the same radio channel, and different radio channel start to a radar system RSM, after that it can be used has judged the radio channel.

[0041] Next, actuation of the equipment constituted as mentioned above is explained. In case a wireless LAN system starts operation, each radio communication equipment sends out the signal for declaring the purport whose self-equipment is an assumed-parents office to other radio communication equipments in a system after powering on, after the time amount which was beforehand changed for every equipment and was set up passes. Moreover, if a declaration signal comes from other equipments before it supervises arrival of the declaration signal from other radio communication equipments and self-equipment sends out a declaration signal in time amount until it sends out the above-mentioned declaration signal, each radio communication equipment will authorize the radio communication equipment which sent out this declaration signal as an assumed-parents station, and will follow directions of this assumed-parents station henceforth. That is, the radio communication equipment which sent out the declaration signal early most serves as an assumed-parents station.

[0042] Now, the radio communication equipment TU used as an assumed-parents office searchs two or more usable radio channels in order by the self system first, receives that radio signal, and judges whether the radar system RSM is using this radio channel for every radio channel by this.

[0043] That is, the wireless carrier signal transmitted by each radio channel is inputted into the 1st Carrier Detect circuit 32 through a low noise amplifier 29 and a band-pass filter 30, after being received by the antenna 27. In this 1st Carrier Detect circuit 32, it is detected whether the receiving level of the above-mentioned wireless carrier signal is more than the 1st Carrier Detect value CSL1 (-47dBm) set up beforehand, and that detecting signal is inputted into radar use judging section 23c of an access controller 23.

[0044] Radar use judging mode presupposes now that it was set as the mode judged using the 1st detecting signal CSS 1 temporarily. If it does so, since the 2nd selector 46 is set as the condition of carrying out the selection output of the detecting signal CSS 1 of the above 1st, in radar use judging section 23c, the detecting signal CSS 1 of the above 1st will be inputted into the number-of-stages protection network 48. In the number-of-stages protection network 48, it is judged whether it exceeded the count of backward alignment guard time by which the count of generating of the detecting signal CSS 1 of the above 1st was beforehand set up within a fixed period.

[0045] Suppose that now RSM, for example, a radar system, was performing the radar search in this condition using radio channels f1-f4. If it does so, whenever the radar pulse signal transmitted from

the radar base station RBS is received, the 1st detecting signal CSS 1 will be outputted from the Carrier Detect circuit 32 of the above 1st. For this reason, the count of generating of the 1st detecting signal CSS 1 will exceed the count of backward alignment guard time within a fixed period, as a result, from the above-mentioned number-of-stages protection network 48, the detection information which shows that it is [radar] under use is outputted, and the detection flag of a register 51 is set.
[0046] On the other hand, a radar system RSM presupposes that the radar search was performed using radio channels other than radio-channel f1 - f4. In this case, since a radar pulse signal is not received in radio channels f1-f4, the 1st detecting signal CSS 1 is not outputted from the 1st Carrier Detect circuit 32. For this reason, in the number-of-stages protection network 48 of radar use judging section 23c, the count of generating of the 1st detecting signal CSS 1 does not exceed the count of backward alignment guard time within a fixed period, therefore the detection flag of a register 51 holds a reset condition.
[0047] Moreover, when a radar system RSM changes a use channel from radio channels f1-f4 to other radio channels, the output of the 1st detecting signal CSS 1 from the 1st Carrier Detect circuit 32 stops. For this reason, in the number-of-stages protection network 48 of radar use judging section 23c, the count of generating of the 1st detecting signal CSS 1 will be less than the count of forward alignment guard time within a fixed period, the detection information which shows that the radar system RSM, as a result, is not using radio channels f1-f4 from the number-of-stages protection network 48 is outputted, and, thereby, the detection flag of a register 51 is reset.
[0048] Moreover, the radio communication equipment TU used as the above-mentioned assumed-parents station judges whether a radar system RSM causes interference by cross modulation, when wireless transmission is performed using the adjoining radio channel with the judgment of the existence of use of each radio channel by the above-mentioned radar system RSM.
[0049] That is, the wireless carrier signal transmitted by each radio channel is inputted into the 2nd Carrier Detect circuit 33 through a low noise amplifier 29 and a band-pass filter 30, after being received by the antenna 27. In this 2nd Carrier Detect circuit 33, it is detected whether the receiving level of the above-mentioned wireless carrier signal is more than the 2nd Carrier Detect value CSL2 (+10.8dBm) set up beforehand, and that detecting signal is inputted into 23d of radar interference judging sections of an access controller 23. In 23d of radar interference judging sections, it is judged whether there is any fear of producing interference by cross modulation to a radar system RSM according to the above-mentioned detecting signal CSS 2, and the judgment result is supplied to wireless access-control section 23e. The radio channel for which the radar system RSM is not using wireless access-control section 23e is detected, and even if other radio channels which moreover adjoin this radio channel perform wireless transmission, if judged with there being no fear of making interference by cross modulation cause in a radar system RSM, the above-mentioned radio channel is directed to each radio communication equipment in a system as a use channel.
[0050] Now, suppose that the operator inputted transmitting directions of packet data in the body 10 of a terminal unit in this condition. If it does so, CPU11 of the body 10 of a terminal unit will judge the condition of the detection flag 51 in radar use judging section 23c of an access controller 23 first. And if the condition of a detection flag 51 checks that it will have been in the reset condition, i.e., the condition of meaning the radar system RSM not using radio channels f1-f4, it writes transmitting packet data in the buffer memory 22 of the wireless LAN adapter 20 through the bus interface 21, and directs transmission of packet data to an access controller 23.
[0051] In response to these directions, an access controller 23 first judges whether other radio terminal units TU of a wireless LAN system are transmitting packet data using radio channels f1-f4 in 23d of wireless access-control sections based on the detecting signal CSS 2 of the 2nd Carrier Detect circuit 33. If judged with no radio terminal unit TU transmitting by this judgment, while sending out the transmitting packet data TD and a transmit clock TCK to a modulation circuit 24 from transmission-control section 23a next, the carrier switch signal CSW is sent out. For this reason, a modulation circuit 24 will be in the condition which can send out a carrier signal, and will start transmission of the modulated-carrier signal of four waves modulated with the above-mentioned transmitting packet data TD after that. In addition, in the 23d of the above-mentioned wireless access-control sections, when judged with radio channels f1-f4 already being used by other radio terminal units TU, transmitting authorization is not given from 23d of wireless access-control

sections to transmission-control section 23a, and, as a result, transmission of transmitting packet data is not performed.

[0052] On the other hand, when the detection flag 51 of the above-mentioned radar use judging section 23c is in the set condition, i.e., the condition of meaning a radar system RSM using radio channels f1-f4, other radio channels which the radar system RSM is not using by 23d of wireless access-control sections are searched. And if other radio channels are found, control for changing into this radio channel the radio channel which should be used (hand off) will be performed. The radio terminal unit TU of the arbitration in a wireless LAN system serves as an assumed-parents station temporarily, and this hand off control is performed when this assumed-parents station sends out a hand off command to other radio terminal units TU in a system.

[0053] On the other hand, a radar system RSM presupposes that the radio channel was changed to the radio channels f1-f4 which the wireless LAN system is using during the period when the radio terminal unit TU has transmitted packet data. If it does so, according to reception of the transmitted radar pulse signal, the 1st detecting signal CS 1 will be outputted from the 1st Carrier Detect circuit 32 from the radar base station RBS in this case. And if the cumulative value of the count of generating of this 1st detecting signal CSS 1 exceeds the count of backward alignment guard time within a fixed period, the detection flag register 51 of radar use judging section 23c will change to a set condition at that time. That is, a detection flag will be in the condition of meaning radio channels f1-f4 using it with a radar system RSM. Change of this detection flag 51 is detected by 23d of wireless access-control sections, and transmission-control section 23a stops transmission of packet data instancy according to this. Therefore, interference active jamming of the radar system RSM by the wireless LAN system is prevented. In addition, the radio terminal unit TU may perform hand off control described previously after this transmitting termination.

[0054] By the way, suppose that other radio terminal units TU with which the radio terminal unit TU is arranged by approaching comparatively by a certain cause during the period which is transmitting packet data, without this wireless carrier signal being undetectable started transmission of packet data. In this case, in the radio terminal unit TU under above-mentioned packet data transmission, since a wireless carrier signal -57dBm or more is received, the 1st detecting signal CSS 1 is outputted from the 1st Carrier Detect circuit 32. That is, in spite of having received not a radar pulse signal but the wireless carrier signal of transmitting packet data, the detecting signal showing the radar pulse signal having been detected is generated. For this reason, it is judged with that by which use of radio channels f1-f4 was started with the radar system RSM, and transmission of the packet data based on transmission-control section 23a is stopped by radar use judging section 23c according to this. That is, transmission will be stopped in spite of not stopping transmission of packet data.

[0055] In order to avoid such a situation, the selection directions information on the register 47 of radar use judging section 23c is rewritten with the body 10 of a terminal unit, and the pulse duration judging signal PSS outputted from the pulse duration judging circuit 42 in the 2nd selector 46 by this is chosen. When it does so, the judgment signal PSS outputted from the pulse duration judging circuit 42 is supplied to the number-of-stages protection network 48, and, thereby, the condition of a detection flag 51 is made to change based on the count of generating of the above-mentioned judgment signal PSS in the number-of-stages protection network 48. Here, the above-mentioned pulse duration judging circuit 42 has the pulse width of the 1st detecting signal CSS 1 shorter than the shortest packet data length (50microsec), or only when longer than the longest packet data length, the judgment signal PSS is outputted. For this reason, when that pulse width is equivalent to a packet data length, the judgment signal PSS is not outputted, but even if the 1st detecting signal CSS 1 is generated from the 1st Carrier Detect circuit 32, when pulse signal length is shorter than the shortest packet data length, the judgment signal PSS will be outputted like a radar pulse signal (1-10micro sec of pulse duration). For this reason, according to the count of generating of the above-mentioned pulse duration judging signal PSS, the detection flag 51 with which a radar system RSM expresses whether it is under [use] ****** for radio channels f1-f4 will be controlled by the number-of-stages protection network 48. Therefore, packet data with large receiving level are incorrect-recognized to be a radar pulse signal, and the situation of stopping transmission of packet data is avoided.

[0056] Although surely the interference to a radar system RSM is prevented from a wireless LAN

system as it is such a high disregard level on the other hand although one was considered as the Carrier Detect level CSL of -57dBm set as the 1st Carrier Detect circuit 32 in the above explanation, the interference to a wireless LAN system from a radar system RSM is not prevented. That is, depending on the receiving level, interference may sometimes be given [enough] to receive-packet data just because the receiving level of a radar pulse signal is less than -57 dms. What is necessary is just to set the 1st Carrier Detect level CSL 1 as the smaller value of for example, +10dBm (-94dBm) extent of thermal noise, in order to reduce this fault. However, it is necessary to detect not only a radar pulse signal but the radio signal which comes from other adjoining wireless LAN systems, when it does in this way, to distinguish a radar pulse signal from the radio signal from other wireless LAN systems, and to detect it.

[0057] It is also effective to use the pulse duration judging circuit 42 described previously as the detection means. However, even if the signal length and the shortest packet data length of a radar pulse signal are almost the same or there is a difference again, in not being a big difference, in the above-mentioned pulse duration judging circuit 42, it becomes difficult to perform an exact judgment.

[0058] So, in order to cope with it in such a case, it is effective to use the periodic signal detection circuit 50 established in radar use judging section 23c. That is, the selection directions information on the register 47 of radar use judging section 23c is rewritten with the body 10 of a terminal unit, and it sets up so that the judgment signal ISS outputted from the periodic signal detection circuit 50 in the 2nd selector 46 by this may be chosen. When it does so, the judgment signal ISS outputted from the periodic signal detection circuit 50 will be supplied to the number-of-stages protection network 48, and the number-of-stages protection network 48 makes the condition of a detection flag 51 change based on the judgment signal ISS of this periodic signal. Here, as stated previously, since it is transmitted at random, generally packet data have clear periodicity for the radar pulse signal to not having periodicity. And paying attention to this point, the above-mentioned periodic signal detection circuit 50 has judged whether it is what detected the radar pulse signal, or the 1st detecting signal CSS 1 or the judgment signal PSS of the pulse duration judging circuit 42 would not detect packet data. For this reason, if these detecting signals CSS 1 or the judgment signal PSS is not a signal which has periodicity whether the 1st detecting signal CSS 1 is generated from the 1st Carrier Detect circuit 32 or the judgment signal PSS is generated from the pulse duration judging circuit 42 and, the judgment signal ISS will not be generated from the above-mentioned periodic signal detection circuit 50. Therefore, according to the count of generating of the judgment signal with which it expresses more clearly that it is the judgment signal ISS, i.e., a radar pulse signal, outputted from the above-mentioned periodic signal detection circuit 50, the detection flag 51 with which a radar system RSM expresses whether it is under [use] ****** for radio channels f1-f4 will be controlled by the number-of-stages protection network 48. For this reason, the fault to which a radar pulse signal, receiving level, and signal length make the packet data of other almost equal wireless LAN systems a radar pulse signal, and do a misjudgment law is reduced, and it enables this to transmit packet data to stability.

[0059] Independently [the 3rd Carrier Detect circuit 34 required as stated above, in order to perform wireless packet transmission to the radio terminal unit TU in this example according to a CSMA method] The 1st Carrier Detect circuit 32 and radar use judging section 23c are prepared. It has judged whether the 1st Carrier Detect circuit 32 detects a wireless carrier signal with larger receiving level than the Carrier Detect level CSL 1, and the radar system RSM is using the radio channel in radar use judging section 23c based on the detecting signal CSS 1. And when a radar system RSM judges that it is [a radio channel] under use, it is made not to transmit the packet data based on this radio channel.

[0060] Moreover, it has the 2nd Carrier Detect circuit 33 and 23d of radar interference judging sections, even if it is the case where a radio signal is transmitted by these circuits using radio channels other than the radio channel which a self system is using, it judges whether cross modulation may be given to a radar system RSM, and when cross modulation may be given, he is trying to forbid use of all radio channels in the radio communication equipment TU of this example. For this reason, the fault which does interference active jamming by cross modulation to a radar system RSM is prevented certainly.

[0061] Therefore, according to this example, in spite of performing the radio transmission of packet data in the wireless area of the existing laser system using the same radio channel, a wireless LAN system can be worked, without having bad influences, such as interference active jamming, to laser system RSM. That is, even if it is the frequency band with which the frequency which can be assigned to a new radio communications system does not remain like a semi- microwave band, a wireless LAN system can be employed.
[0062] Moreover, the pulse duration judging circuit 42 is formed and it enables it to judge the existence of use of the radio channel by the radar system RSM in this example based on the judgment signal PSS of this pulse duration judging circuit 42 as a means for judging the existence of use of the radio channel by the radar system RSM in addition to the 1st Carrier Detect circuit 32 which judges receiving level. Therefore, the fault which incorrect-recognizes receive-packet data with large receiving level to be a radar pulse signal is reduced, and the situation of stopping transmission of packet data superfluously by this is avoided.
[0063] Furthermore by this example, as a means for judging the existence of use of the radio channel by the radar system RSM Newly form the periodic signal detection circuit 50, input into the above-mentioned periodic signal detection circuit 50 the detecting signal CSS 1 of the 1st Carrier Detect circuit 32 which judges receiving level, or the judgment signal PSS of the pulse duration judging circuit 42, and the existence of the periodicity is judged. It enables it to judge the existence of use of the radio channel by the radar system RSM based on this judgment signal ISS. When it follows, for example, disregard level CSL1 of the 1st Carrier Detect circuit 32 is set up low, and even when it is difficult between the signal length of a radar pulse signal, and the shortest packet data length to judge a laser pulse signal by receiving level or pulse duration like [in case there is no clear difference], the existence of use of the radio channel by the radar system RSM can be judged correctly.
[0064] In addition, this invention is not limited to the above-mentioned example. For example, the mode judged based on the detecting signal CSS 1 of a. receiving level in the above-mentioned example as the mode for judging the existence of use of the radio channel by the radar system RSM.
b. The mode judged based on the detecting signal CSS 1 of receiving level, and the pulse duration judging signal PSS.
c. The mode judged based on the judgment signal ISS showing the existence of the detecting signal CSS 1 of receiving level or the pulse duration judging signal PSS, and its periodicity. The ******** case was described. However, the mode judged based on d. pulse duration judging signal PSS as the other mode.
e. The mode judged based on the judgment signal ISS showing the existence of periodicity.
You may use it.
[0065] Moreover, you may apply in order to judge whether an interference according the judgment approach which uses each above mode alternatively to cross modulation may be given to a radar system. Moreover, you may constitute so that LED and LCD may be used for a radio communication equipment and the judgment result may be displayed on it.
[0066] Furthermore, although said example explained taking the case of the case where share the radio channel of a radar system RSM and a wireless LAN system is built, otherwise a cellular automobile and a cellular-phone system, selective-calling communication system, an MCA system, yard mobile radio communication system, etc. and a radio channel are shared, and you may make it build a wireless LAN system.
[0067] In addition, also with the configuration of the class [of 2nd wireless system], configuration, class [of radio communication equipment] and configuration, 1st, and 2nd judgment means, the configuration and control procedure of a radio-channel use control means, and the transmitting procedure of transmitting packet data, in the range which does not deviate from the summary of this invention, it deforms variously and can carry out.

[Translation done.]

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The outline block diagram of the radio communications system concerning one example of this invention.
[Drawing 2] The circuit block diagram showing the configuration of the radio terminal unit of the system shown in drawing 1 .
[Drawing 3] The circuit block diagram showing the configuration of the radar use judging section of the radio terminal unit shown in drawing 2 .
[Description of Notations]
RSM -- Radar system RBS -- Radar base station
LSM1-LSM3 -- Wireless LAN system
TU11-TU34 -- Radio terminal unit
10 -- Body of a terminal unit 11 -- CPU
12 -- Memory 20 -- Wireless LAN adapter
21 -- Bus interface section 22 -- Buffer memory
23 -- Access controller 23a -- Transmission-control section
23b -- Reception-control section 23c -- Radar use judging section
23d -- Radar interference judging section 23e -- Wireless access-control section
24 -- Modulation circuit (MOD)
25 -- Transmitted household-electric-appliances force amplifier 26 -- Circulator
27 -- Antenna 28 -- High frequency switch
29 -- Low noise amplifier 30 -- Band-pass filter
31 -- Demodulator circuit 32 -- 1st Carrier Detect circuit
33 -- 2nd Carrier Detect circuit 34 -- 3rd Carrier Detect circuit
41 -- Buffer amplifier
42 -- Pulse duration judging circuit 43a, 43b -- Register
44 -- The 1st selector 45 47 -- Selection directions register
46 -- The 2nd selector 48 -- Number-of-stages protection network
49a, 49b -- Count register of protection 50 -- Periodic signal detection circuit
51 -- Detection flag register (detection flag)

[Translation done.]

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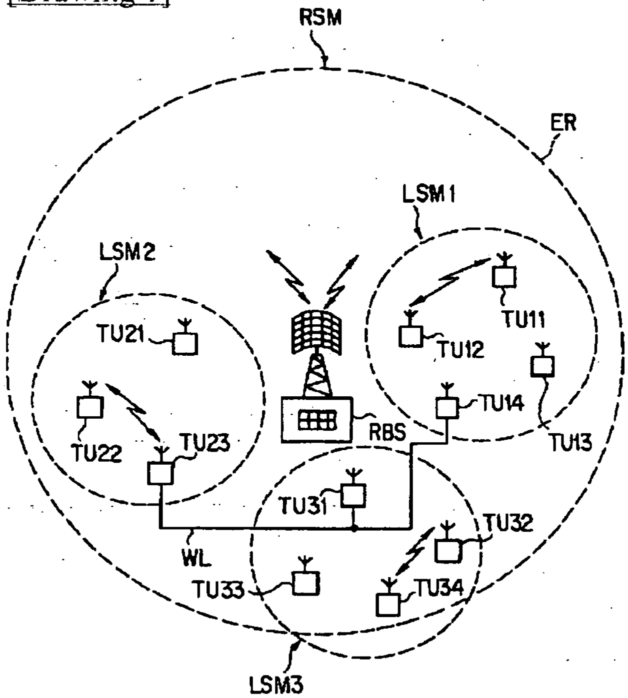
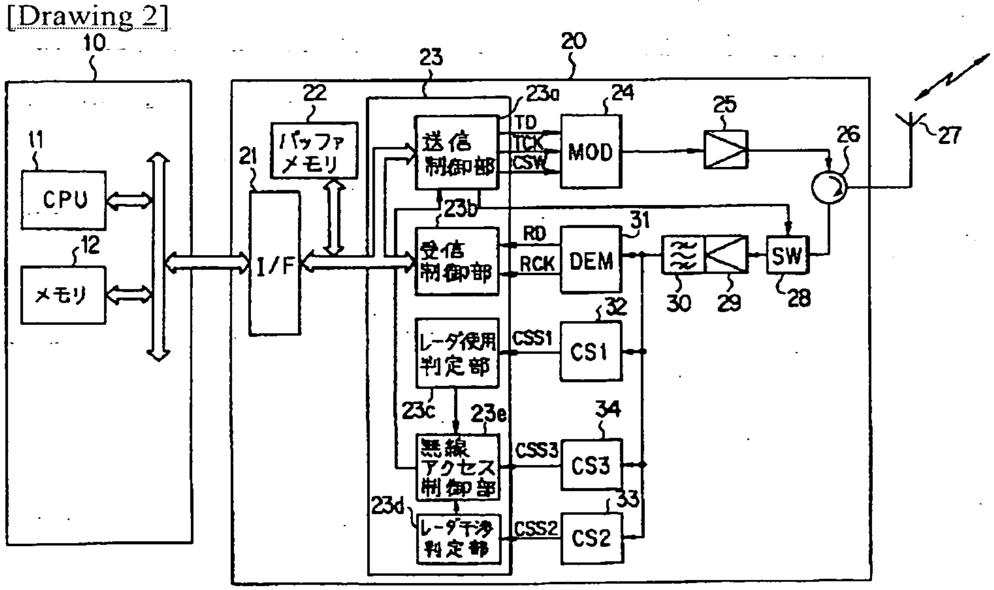
DRAWINGS

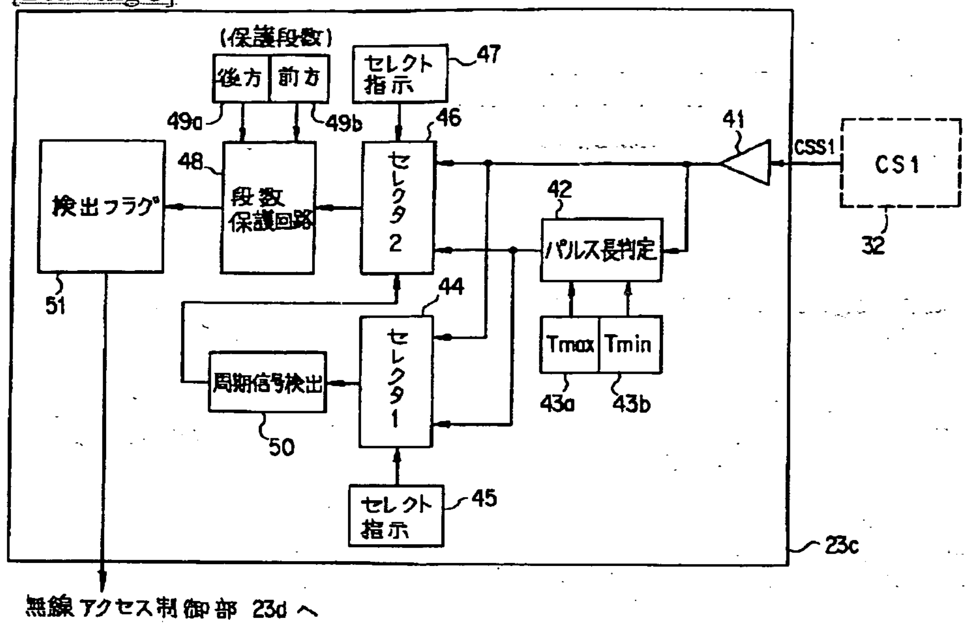
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]